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THE TREATMENT OF

DISEASES

OF THE

NERVOUS SYSTEM

A MANUAL FOR PRACTITIONERS

BY

JOSEPH COLLINS, M.D.

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PREFACE.

Some time since there was forced upon me an appreciation of the necessity for a work on the treatment of nervous diseases, wherein should be set forth in detail the management of what are still considered obscure and puzzling affections. Each year many physicians, after having practised their profession for a longer or shorter time, come to New York to freshen their intellectual possessions and to revive their professional interests. Contact with them has convinced me that their particular demand is for aid in the treatment of stubborn cases similar to those previously encountered and for assistance in the recognition and interpretation of obscure maladies. They also seek instruction in the art as well as in the science of therapeutics. In preparing this handbook I have endeavored to keep in mind these needs of the general practitioner. To set forth clearly and adequately the most approved current methods of treating nervous diseases has been my conscious purpose. As the trend in the management of such cases is to rely less upon drugs than upon hygienic and physical measures, particular attention has been given to a consideration of these and the mode of their utilization. In the ordinary text-book of nervous diseases, hydriatics, massage, rest and exercise, electricity and psychotherapy are briefly discussed, but, as a rule, nothing is said in detail of the art of their application. Thus the reader is left to gather the needed information where he will, and usually he is forced to consult special works on the different subjects in order to obtain it. I have assumed that the reader has sufficient knowledge to recognize the more familiar nervous diseases. Therefore, a brief summary only of their symptoms is given. A few rare, and practically unimportant affections of the nervous system are not considered at all. I trust that such studied omission may add to the usefulness of the treatise as a handbook for general practitioners.

As the intelligent and satisfactory treatment of all morbid conditions requires some familiarity with their causation, the etiology of the diseases of the nervous system has been given extensive consideration. It will be noticed that no attempt at classification has been made. The subjects have been taken up one after another in the following order, which is practical if not logical: Diseases of the brain, of the spinal cord, of the peripheral nerves, of the sympathetic nervous system, and finally the

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functional nervous diseases, and the most common symptomatic manifestations, such as headache, delirium, convulsions, hemiplegia, and insomnia.

Some of the diseases have been considered at greater length than others. It may even appear to the casual reader that a disproportionate amount of space is given to a discussion of headache, neurasthenia, and other functional and symptomatic states in contrast with that devoted to brain tumors, multiple sclerosis, and other organic diseases. This has been intentional. The disorders of the former class are of far more frequent occurrence, and cause much more suffering than the latter. Therein, to say nothing of their greater amenability to appropriate treatment, is found ample justification for their detailed consideration.

In the compilation of the statistical data in a few of the chapters I have been aided by some of the gentlemen who are or who have been assistants in my clinic. Dr. Carlin Phillips, Dr. L. J. J. Muskens, Dr. I. Abrahamson, and Dr. R. E. Peck have placed me under obligations for such assistance in the preparation of the chapters on Neurasthenia, Paralysis Agitans, Chorea, and Chronic Myelitis, respectively.

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THE TREATMENT

OF

DISEASES OF THE NERVOUS SYSTEM.

PART I.

CHAPTER I.

THE CAUSES AND ORIGINATION OF DISEASE OF THE NERVOUS SYSTEM.

The art of treating diseases of the nervous system is doubtless practised with more aptitude and certainty than it was a generation ago. However gratifying this progress may be, it is nevertheless far from being commensurate with the advance of neurology in other directions, notably in the comprehension of the structure and functions of the nervous system. The discoveries of minute anatomy and cell physiology have contributed less to the therapy of nervous diseases than have altered views as to the causation and origination of pathological processes in the nervous system. The most important of these is the recognition that the causes of nervous diseases are identical with those provocative of disease in other parts of the body. Even the pathogenesis of diseases of the nervous system is similar to that of other diseases of the body. In consequence of this the treatment of diseases of the nervous system can give promise of successful issue only when the consultant or physician has at his command a knowledge of the origination and causation of disease at least as comprehensive as that of the adequately equipped general practitioner. Another noteworthy contribution to the therapy of nervous diseases is attributable to the general recognition of the prophylactic and remedial value of physical measures.

An examination of the causes and conditions of the origination of nervous diseases must avoid details of pathogeny and the intricacies of symptomatology and specific treatment. So far as these constitute integral parts of this treatise, they await consideration in subsequent chapters. We are at present concerned with the more general but none the less important medical and social problems involved. Even a brief presentation of these is surrounded with many difficulties, and many important topics

will of necessity be given much less than the full and complete discussion they would receive in a more extensive treatise on the immediate and remote causes of neuropathology. Among these difficulties perhaps the most considerable flow from the intimate relationship subsisting between organic and functional diseases of the nervous system and diseases of other parts of the body. This will make necessary some reference to other ailments when the prevention of nervous diseases is discussed.

The interaction of the nervous system and other systems of the body in immediate connection with it causes all parts of the body to respond to the far-reaching influence of the diseased nervous system, so that many disparate symptoms may result from the same pathological condition. Thus the destruction of the continuity of a neuraxon (axis cylinder) determines the complete degeneration of the part cut off from connection with the cell body of the neuron, whereby a lesion that may legitimately be considered slight and trivial in other tissues will as an affection of the central nervous system give rise to profound destructive changes in remote parts.

No less provocative of obscure and mystifying modification of the normal functions is the influence that the mind exerts upon almost all tissues of the organism and their functions. Every mental condition is undoubtedly the accompaniment of some cortical excitation; but resort to a description of the exciting agent in terms of mental phenomena is frequently necessary, because psychological entities—ideas, emotions, sensations, and the like—are readily ascertained and described, although their physiological bases may withhold themselves from our understanding. A similar guide post pointing the scientific limitations of neurology is the differentiation of functional diseases from organic diseases. Although this differentiation is still necessary, it is the hope of neurology to be able to explain all functions in terms of structure, not necessarily the gross structure of an organ, but at least in terms of chemical constitution. In the present state of knowledge of the pathogenesis of the nervous system it remains not only convenient but necessary for us to consider degenerative changes and ameliorating treatment, as these may be directed to the structures of the nervous system, to its physiological functioning, or to its psychological manifestations.

A consideration of the origin of the diseases of the nervous system falls naturally into an examination of (1) those hereditary and congenital conditions which are sometimes the sole cause of such diseases, or which constitute, in most patients at least, the groundwork for their development; (2) those acquired or accidental causes which are the active agencies in determining the onset of the particular pathogenic process in the patient.

Hereditary and Congenital Influences.—A few diseases of the central nervous system take their origin within the lifetime of the individual without any apparent attributable cause. The search for the origin of these

diseases leads to an examination of the family history of the subject and also of the conditions during or immediately preceding fœtal life. If the disease in question has appeared under similar conditions in one or more of the remote or immediate ancestors of the patient, a satisfactory explanation of its existence refers its causation to heredity. The hereditary diseases are comparatively rare. Among them we can enumerate with certainty only Huntington's chorea, Thomsen's disease or so-called myotonia congenita, migraine, and the hereditary ataxias, spinal and cerebellar. Some of these are not strictly hereditary. No satisfactory explanation of the conditions determining the transmission of these diseases from parent to offspring has yet been offered. The problem of the direct inheritance of a pathological condition must be referred to the biologist for solution; it is a part of the larger problem of the transmission of secondary characteristics.

Congenital diseases of the nervous system are due to causes which act directly upon the fœtus, or to causes which have, previous to conception or during pregnancy, so affected the mother that the child at birth already carries within it those modifications of structure which will eventuate in the outbreak of disease independent of other causation. The congenital diseases of the nervous system are more numerous than the hereditary, even if we exclude congenital syphilis, which, of course, is liable to cause disease of the nervous system later in life.

So-called family nervous diseases—a class whose number is constantly growing larger—require special mention. Family diseases are characterized by their appearance in more than one member of the progeny of non-consanguineous, healthy parents, who are entirely free from all evidences of the diseases and indeed from the neuropathic diathesis. In some instances these diseases appear in only one member of the family, such, for instance, as an isolated case of amaurotic family idiocy or family dystrophy. Nothing is known of the real causation of these diseases. As other factors are excluded, they would seem to depend upon unsuitability of the sperm and the ovum of the parents. Either parent might produce healthy children if mated with another person. The early death or sterility of patients in whom these diseases have their apparent spontaneous origin precludes demonstration of their hereditability. It is not positively deniable that a disease appearing for the first time in the members of a single generation of a family with no traces of such taint may not be inheritable; but this would seem to set at naught the currently accepted doctrine of biology that acquired characteristics are not inherited. For the present, children thus congenitally burdened must be looked upon as analogous to those individuals of a species of organism to which the biologists have applied the name "sports."

The Neuropathic Diathesis.—Although the strictly hereditary nervous diseases may be few in number, and consequently come but seldom within

the purview of the family practitioner, the inheritance of the neuropathic diathesis is of such frequence as to be of the first importance. Two persons of the same age and apparently of the same constitution may take a similar excessive quantity of alcohol, or be subjected to a similar amount of other stimulation from the environments, such, for example, as physical or mental shock. At the end of a year or of five years, one develops perhaps a multiple neuritis, an occupation neurosis, neurasthenia, or some other nervous disease, while the other remains apparently unharmed. Inquiry into the family history of the latter may show that other members of this family have offered unsuccessful resistance to the excitants of nervous diseases. This evidence of an unstable nervous organization may not be manifested in the same direction in one individual as in another. The repeated occurrence of any nervous disease in near or remote ancestors or even in side lines is sufficient to establish the probability that the patient has inherited the neuropathic diathesis or constitution. The real nature of the neural unstability it is hoped some time to discover. At present, we are compelled to fall back for an explanation upon the assumption that with the development of the nervous system the various constituent cells receive an endowment of energy which is in definite correlation with the constitution of such neural structure. If this endowment is sufficient to meet the requirements of normal life, in other words, if the potential energy of the cell is up to the hypothetical standard which is determined by the work demanded of it from an average human environment, the nervous tone of the individual is a stable one. If, however, the endowment of energy is deficient, and thus an excessive demand is made by a normal environment on the cell, or if the endowment is excessive and results in the overaction of the cell to the stimuli of the environment, the drain upon that cell or upon other cells of the nervous system with which it is in connection will ultimately manifest itself in diseases which represent either a neural fatigue or neural hyperexcitability. This incompleteness or abnormality of neural development need appear only in physiological process or in mental activity. Upon microscopical examination the components of the nervous system may present the strictest anatomical integrity.

The manner in which the constitution of the parents determines this insufficient or excessive endowment of the constituent cells of the nervous system is also but little understood. It may result from the presence of constitutional disorders that exist either before the maturation of the germ plasm or at the time of the development of the proton of the nervous system, or indeed at any period between the protal deposition and its complete development. These constitutional disorders operate most frequently to impair the general nutrition of the parent. This impairment of parental nutrition may exert its influence upon the germ substance at the moment of its first detachment from the parent or during any part of

the period of its independent development, although these metabolic factors may have a more determining activity in the implantation of a neuropathic diathesis at the critical moment of the first appearance of the proton of the nervous system. The equable evolution of the fœtus may be interfered with in a number of ways during the whole period of its development, through the sympathetic nervous system of the mother which is the controller or regulator not only of her own nutrition, but of the nutrition of the fœtus as well. Factors acting to impair the nutrition of the mother's sympathetic system will condition an altered metabolism of the fœtus. This deleterious influence will be exaggerated in those parts wherein the metabolic process is most active in furthering the development of the different constituent systems of the forming individual. As the fœtus reaches the stage of development at which its metabolism begins to proceed in partial independence of the maternal connection, alterations of its own vegetative system may produce functional deficiency of the cerebrospinal system. The general development of the fœtus and of the child after birth proceeds under certain control and guidance of the forming nervous system. Perversions of nutrition conditioned by the vegetative nervous system of the mother will be therefore most exquisitely manifest in derangement of the fœtal neural constitution, but these will also determine perversions and abnormalities of peripheral structures. The organism which has been thus subject to impaired metabolism in the way indicated is endowed with nervous tissue of increased vulnerability. It will require only some accidental cause, such as infection, intoxication, or exhaustion, operating in a degree that would be harmless to a system of standard efficiency, to cause this vulnerability to manifest itself in some perversion of function of the parts involved.

The nervous diseases that result in consequence of normal stimuli acting upon a nervous system of exaggerated vulnerability are appropriately designated neuroses of degeneration. They present symptom complexes which indicate not only degeneracy of the nervous system, but a similar status of insufficient or excessive development of other associated tissues. Certain bodily and mental stigmata which are often the concomitants of these degenerative diseases are indications of a general pathological departure from the normal type or standard of the human race.

Stigmata of Degeneracy.—The stigmata of degeneracy of the body are much more easily detected than those of the mind. What is normal in a Mongolian is decidedly pathological in a Caucasian, while the cranial conformation of a Teuton occurring in a Celt would indicate a degree of abnormality. Even the family type of structure must be taken into consideration. The existence of any one or of even a limited number of these stigmata of degeneration does not permit of the undoubted assumption of degeneracy; but a human being who possesses a number of the

well-recognized indications of degeneration either somatic or psychical is properly designated a degenerate. The extremities are perhaps the most delicate indices of a departure from the normal course of development taken by the family or race to which the individual belongs. In general a marked departure of any tissue from the structural norm or average of the human race is indicative of the possibility of a general degeneracy entailing among its implications a neuropathic diathesis and exaggerated neural vulnerability.

The somatic stigmata most frequently pointed out are malformations of the cranium, too large, too small, or asymmetrically developed head; defective lobulation, formation, and relative position of the ears; the occurrence of a Darwinian tubercle, absence of the helix, deficient tragus or antitragus; abnormal shape of the ocular aperture, a tapering internal canthus, an approach to the Mongolian eye; irregular or insufficient pigmentation and asymmetry of the iris; unduly developed, prognathous jaws, an accentuation of the inferior angular process constituting the Lamarckian hypophysis; defective conformation of the palate, an excessively vaulted arch, the development of a ridge along the centre known as the torus palatinus; asymmetrical or bifid uvula; anomalies of dentition; disproportionate length of the upper extremities, and particularly of the index finger; undue projection of the os calcis, excessively arched or otherwise abnormal feet; bodily anomalies, either general, such as giantism or dwarfishness, infantilism or precocious senility, femininism or masculinism, or special, as spina bifida.

The functional stigmata comprise physical retardation and precocity, the excess or deficiency of physiological processes, such as in walking, talking, sexuality, the hyperæsthesia or hypæsthesia of any sense organ, etc. A mental indication of degeneracy is found in similar conditions of any psychical activity, instinct, or emotion. A want of balance in conduct, thought, or feeling is frequently the most noticeable mental stigma.

The abnormalities and deficiencies which constitute stigmata of degeneration may be found in either of the two recognized classes of degenerates: the superior and the inferior. Superior degenerates are those who may be possessed of sufficient mental capacity to command notoriety or distinction, but yet fail to reveal the mental balance indicative of normality. They are the decadent artists, poets, æsthetes, and some occupying the front rank in all regions of intellectual activity. The inferior degenerates, on the other hand, are possessed of mental qualifications below the normal. They are for the most part dependent upon others for the maintenance of their existence. This class includes the idiot, the idiot savant, and many members of society who are stamped with ineffectiveness. The superior degenerate frequently has as many and as striking stigmata of degeneration as his brother, the inferior degenerate.

Acquired and Accidental Causes.—The causes which may excite diseases of the nervous system in those who have or have not an inherited or acquired neuropathic diathesis are grouped under the following heads: (1) infections; (2) intoxications; (3) physical trauma; (4) psychical trauma—including moral and emotional shock, mental and physical crises, social and pedagogical influences. Any one of these exciting causes may be sufficient to awaken nervous disease in an entirely healthy subject. Most frequently the causation of nervous disease embraces many complicated factors. In ascertaining the causes of disease of the nervous system, or in searching for the proper means to prevent its occurrence, due regard must be had to the possible existence of the neuropathic diathesis. A proper appreciation of the manner in which trifling stimuli may evoke profound disorder when acting upon certain constitutions will enable the general practitioner to render important service in preventing the occurrence of these diseases or in checking their development before irremediable injury has been done.

The Rôle of Infection.—The rôle played by infection has only lately gained the recognition which is its due. Although the nervous system by virtue of its embryological origin offers a greater resistance to the excitants of disease than do other tissues of the body, nevertheless it is susceptible to the same injurious influence. The pneumococcus, for example, causes reactive inflammation by preference in the lungs; the bacillus of influenza attacks chiefly the respiratory mucous membrane. Nevertheless the nervous system is very vulnerable to these organisms, the first being the commonest cause of meningitis, and the second a common cause of encephalitis. The tubercle bacillus may produce myelitis as well as tuberculous peritonitis. In short, the specific infections may and do attack the different components of the nervous system, just as they attack other tissues of the body. The greater immunity of the nervous system is perhaps due only to its greater inaccessibility. It has not yet been proved that any disease of the nervous system is dependent upon an organism that causes a specifically nervous disease. It seems unlikely, moreover, that the future will show that such a disease exists. Although the preponderance of testimony and evidence at the present writing is to show that anterior poliomyelitis, Landry's paralysis, and possibly some other diseases of the nervous system, such as beri-beri, are dependent upon specific organisms, these have not yet been isolated. When they are, it will probably be found that they are in reality bacteria which cause more common diseases in other parts of the body. It is only latterly that it has been shown that the common infections, such as those of pneumonia, typhoid fever, diphtheria, erysipelas, malaria, and the like, are causative of many of the acute organic diseases of the nervous system. It is not yet generally recognized how important are these in causing or contributing to the occurrence of chronic nervous diseases.

The infections exercise injurious activity upon the nervous system in one of two ways. Thus, the infectious agency may act specifically upon the nerve substance to produce a characteristic inflammatory or degenerative reaction. Such, for instance, is the effect of the pneumococcus upon the meninges to produce acute leptomeningitis, the effect of the tubercle bacillus upon the constituents of the spinal cord to produce acute myelitis, and the effect of the lepra bacillus upon the peripheral nerves to produce neuritis. The deleterious effects of such infections upon the nervous system occur soon after the admission of the organism to the system. The pathological changes which they cause in the nervous system are not always due to the immediate presence or action of the specific infection. For instance, there is no positive proof that diphtheritic multiple neuritis is due to the direct action of the specific organism of diphtheria. On the contrary, it is generally accepted that the lesion of the nerves is due to the action of toxic materials engendered or produced by the presence of the specific bacilli in the system. It may be said, therefore, that diseases of this kind are the result of the activity of the infection itself or of post-infectious intoxication. Just how long such intoxication remains of sufficient potency to excite disease within the system, even in tissues that offer feeble resistance, no one can say. It is, however, an undeniable fact that the infections are capable of exercising their deleterious effects upon the different parts of the nervous system very remotely. This remote action of the infections constitutes the second mode in which they operate to produce nervous diseases. So far, no adequate explanation has been given of the manner of their action. They may have only an indirect influence in depressing the nutrition of certain parts of the nervous system. Degeneration may then follow or intercurrent and accidental agencies may acquire an unwonted power. The most plausible explanation, however, is that during the course of an infectious disease certain toxins are generated which remain in the system and establish by the perversions of nutrition which they cause a more or less permanent source of neural intoxication. Thus a persistent attack upon the nervous tissue is maintained until its integrity is overcome. That this toxic material does not partake of the nature of the infection from which it takes its origin and that the disease which it causes is of a different structural nature are generally recognized.

The explanation that is offered to account for the remote development of nervous diseases after infection is analogous to that which is given to explain the syphilitic origin and causation of tabes and general paresis. These latter diseases are no longer considered syphilitic, but parasyphilitic, and the organic diseases of the nervous system (such as disseminated sclerosis and other degenerations which, it is generally admitted, stand in relationship to the occurrence of the acute infectious diseases, even though the time that elapses between the existence of the

former and the appearance of the latter is very great) might quite as legitimately be referred to as parainfectious diseases. No one to-day believes that tabes is pathologically a syphilitic disease. Still, nearly every one believes that if syphilis were swept from the face of the earth, locomotor ataxia would not occur. Between the period of the existence of the syphilitic virus *per se* and the development of the morbid processes constituting the anatomical basis of tabes dorsalis there develops a poison, or something due to the former and provocative of the latter. What this intermediary peccant substance is we can only conjecture. Nothing is known of its constitution, and we are equally ignorant of the measures that should be taken to check its development. Naturally, it follows that if the syphilitic virus is overcome, the toxin will not develop. As has been said, some such explanation as this must suffice at the present time to interpret the relationship between infectious disease and the remote occurrence of disease of the nervous system.

Syphilis and Nervous Disease.—The relation of syphilis to the occurrence of functional and organic nervous disease is such an important one that I shall devote particular attention to it. There is no designation that is applied more loosely than "syphilis of the nervous system." We continually hear it spoken and see it written as though it were a disease with well-defined anatomical foundation and unvarying morbid changes. The term must perforce convey an obscure idea or conception of the pathological states which result from the activity of the syphilitic virus or peccant substances which are the result of its existence, because these are not only manifold, but the different tissues of the nervous system and the different components of them may be affected. One might as justifiably speak of "infection of the nervous system," and hope to convey an adequate idea of the morbid changes produced by infection and of the clinical conditions dependent thereon, as he does by using the term syphilis of the nervous system. Yet probably no one would speak of infection of the nervous system with the hope of conveying without further exposition the clinical or pathological concept of a disease. We know, for instance, that infection produces neuritis, poliomyelitis, encephalitis, and meningitis, but we do not describe them, clinically at least, under the general caption of infection of the nervous system. Yet this is similar to what many writers attempt when they speak of syphilis of the nervous system and give its so-called pathology, etiology, and clinical delineation as though it were a disease *sui generis*.

Personally I am convinced that the result of such attempt is to obscure the physician's conception of the colossal rôle played by syphilis in the causation of nervous diseases, particularly organic nervous diseases. Unquestionably the activity of the syphilitic virus in one tissue is manifested by morbid changes which parallel those resulting from its activity in other tissues, the structural differences of the two lesions being condi-

tioned by the histological character of the tissue, by its physiological state, and by the intensity of the syphilitic poison; and by virtue of this fact it may be contended that there is sufficient reason for the designation syphilis of the nervous system. On such grounds alone, it would be impossible to deny the assumption. But it may be said that the consequences of bacterial infection, such as from the pneumococcus, the diplococcus intracellularis, the bacillus of influenza, and the undiscovered organisms of infectious anterior poliomyelitis and encephalitis, are of as comparable constancy and similarity as those produced by the activity of the syphilitic poison. Moreover, the variability of the morbid results is dependent upon the same conditions, viz.: upon the histological structure, the physiological state, and the intensity of the infection. Thus it must be granted that we are not justified in singling out certain diseases of the nervous system and subjecting them to classification on an etiological basis, particularly when the pathogenic causation is really unknown, as it is in syphilis, and at the same time neglecting to adopt similar classification for other conditions of which the entity of causation has been established beyond doubt. Of course, it may be said of the infectious diseases that although they are all dependent upon bacterial causes, each one of them owes its existence to an individual organism. This, however, is not germane to the discussion, for our contention is merely that the single infectious organism, such, for instance, as the pneumococcus, may cause different inflammatory diseases of the nervous system and its covering, dependent upon the tissues which are affected. Yet no one would think of attempting to convey to a person unfamiliar with these various diseases the pathological and clinical history of them under the single caption of infection of the nervous system. In order to simplify the matter and to facilitate comprehension, he would describe them under the separate captions of meningitis, encephalitis, poliomyelitis, etc. In other words, it has been found most expedient to classify the resulting conditions topically and clinically. The time may come when nervous diseases can be classified on a strictly etiological basis. When it does we shall speak of infectious nervous diseases, syphilitic nervous diseases, traumatic nervous diseases, toxic and autotoxic nervous diseases, nervous diseases dependent upon defective development, and so on. While this may simplify the subject of pathogenesis, any attempt to apply it clinically will result in enormous confusion; and we shall undoubtedly be obliged to continue classifying nervous diseases, as well as all other diseases, topographically.

After these introductory remarks, which are made that it may be known that the inadvisability of considering at any great length syphilis of the nervous system in a treatise on the treatment of nervous diseases is fully appreciated, I proceed to discuss briefly the commoner manifestations of syphilis of the nervous system, and reserve for their more de-

tailed consideration space in the chapters on the treatment of individual diseases which are caused, more or less frequently, by syphilis. This will give an opportunity in this place to consider the general features of the causation of diseases that are commonly due to syphilis, and to take a brief survey of the most approved methods of treating them. Naturally, it is impossible when discussing the treatment of myelitis, encephalitis, tabes, neurasthenia, or other diseases that may or may not be due to syphilis, to revert to any considerable extent to the most approved methods of treating syphilis, to the time when such treatment should be begun, or to the duration of treatment, but in a general chapter on prophylaxis these topics can be appropriately considered. The most cogent reason for devoting so much space to a general consideration of the effects of syphilis of the nervous system is that the vast majority of the organic nervous diseases occurring during adult life which are not the result of infection or defective evolution are due to syphilis.

Diseases of the nervous system due to syphilis must be divided, temporally and pathologically, into syphilitic and parasyphilitic. The former are characterized by their development during the period of activity or life history of the syphilitic virus, and by the occurrence of inflammatory, exudative, or productive conditions peculiar to the existence and activity of this virus. The latter occur after the syphilitic poison has ceased to exist as such, or at least after it has lost the power to cause characteristic pathological reaction in tissues. They are distinguished by the occurrence of primary decay which may be, and frequently is, comparable in every respect to that produced by other causes. These two varieties of syphilitic disease of the nervous system are often spoken of pathologically as the exudative and degenerative; but this may easily lead to confusion, as degenerative conditions of nerve tissue may and often do occur sequentially to exudative syphilitic states. Parasyphilitic nervous diseases, it must be borne in mind, are degenerative *ab initio*. They are not preceded by exudative and proliferative states, nor are the lesions after death at all characteristic, macroscopically or microscopically, of a luetic process.

The syphilitic virus may attack any portion, segment, or constituent of the nervous system. It may attack them individually or collectively, and naturally the results will be very different as it does one or the other. Thus, we may subdivide the genuine syphilitic diseases of the nervous system into: (1) Syphilitic disease of the blood-vessels; (2) syphilitic disease of the parenchyma of the central nervous system; (3) syphilitic disease of the coverings of the central nervous system, particularly the meninges; (4) syphilitic new formations of sufficient size to deserve the name of tumor; and (5) syphilitic neuritis, a condition that is rare, but whose actual occurrence would seem to be fairly well substantiated.

The parasyphilitic diseases are: (1) Tabes dorsalis; (2) general pare-

sis; and (3) some neuroses, including syphilitic neurasthenia, epilepsy, neuralgia, and possibly hysteria.

Topographically, syphilis of the nervous system may be divided into syphilis of the intracranial contents, syphilis of the intraspinal contents, and syphilis of the peripheral nervous system. This classification serves no useful purpose, unless it be to impress that different constituents of the intracranial or intraspinal contents may be simultaneously affected. In fact, a condition known as cerebrospinal syphilis has come to be described as a pathological and clinical entity. This has been necessary because the morbid conditions forming its basis—viz.: a diffuse gummatous meningoencephalitis and meningomyelitis, the basilar portion of the brain and the cervical spinal cord being especially liable to involvement—and the symptoms dependent thereon do not really parallel any other disease. Sufficient has been said, therefore, to show that the term syphilis of the nervous system is applied to very differently located pathological processes, and that no excuse for the use of such nomenclature to indicate a particular lesion or an individual pathological change can be put forward. The only generic term at this time that is warranted is multiple cerebrospinal syphilis, which stands for a diffuse, widespread, gummatous meningitis of the brain and spinal cord, with secondary involvement of these organs. It constitutes a pathological and clinical entity, the symptomatology being that of syphilitic meningitis, plus syphilitic encephalitis and myelitis in variable and varied amount.

The Causes of Syphilitic Nervous Diseases.—On first sight it might appear that a discussion of the etiology of syphilitic nervous diseases was unnecessary, as they are all due to syphilis, but when we consider the vast amount of syphilitic infection and the comparatively small amount of syphilitic nervous diseases, despite the fact that so many nervous diseases are due to syphilis, it must be seen that there are other factors than the existence of syphilis that materially predispose to or facilitate the occurrence of syphilitic affection of the nervous system. Infection by the syphilitic virus is the *sine qua non*. The point of entrance of this infection into the system may be any exposed part of the body which has an abrasion upon it, but commonly it is the external genital organs. Tradition and widely accepted belief both have it that the local manifestation of such infection is an ulcer with firm base and indurated margins, to which the name true, hard, or Hunterian chancre is given. It is more than likely, however, that the syphilitic virus may inoculate an abraded surface without being followed by the occurrence of what is considered to be a true Hunterian chancre. In other words, there can scarcely be any question that the soft chancre is sometimes the local expression of syphilitic inoculation or at least the point from which the syphilitic virus enters the system. I take it that few will deny that the arbitrary differentiation made by many syphilog-

raphers between hard and soft chancre, as syphilitic and non-syphilitic, is no longer tenable. This is tantamount to the admission that the inoculation of syphilis does not necessarily produce a characteristic local lesion, even though the vast majority of instances are characterized by the occurrence of a more or less typical ulcer to which the name hard chancre is given.

The period that elapses between the initial lesion of syphilitic infection and the exudative manifestations of syphilis in the nervous system was formerly considered to be much longer than we now know it to be. When the phenomena of syphilis were classified uniformly on a temporal basis into primary, secondary, and tertiary, it was customary to state that involvement of the nervous system (meninges, blood-vessels, or parenchyma) was a late tertiary manifestation. Such a position is entirely untenable and it is held at the present time by few writers. At least one-half of the cases of true syphilitic disease of the nervous system occur within the first three years after infection. Braus, basing his statements on investigation of a large number of cases, states that forty-two per cent of cases of intracranial syphilitic disease occurs within the first year; and Mauriac found as the result of his studies that forty-three per cent of cases of cerebrospinal syphilis occurs within the first two years. It may therefore be said without fear of contradiction that the liability to true syphilitic nervous disease is enormously greater during the first ten years succeeding infection than in all the other years of the infected person's life, and that the liability during the first five years after infection is much greater than during the next five. Parasyphilitic nervous diseases, on the other hand, are much more likely to develop during the latter half of the first decade after infection, the average period that elapses between the original infection and the first manifestations of such disease being about ten years.

The predisposing factors to the occurrence of syphilis of the nervous system are, so far as they have been determined, first, the intensity of infection, judged principally by constitutional manifestations; second, insufficiency of antisyphilitic treatment; third, the age of the patient; fourth, the seat and apparent nature of the initial lesion; fifth, individual peculiarities or constitutional conditions; sixth, physical injuries; seventh, mental excitation, exhaustion, enervating habits and vicious indulgences, under which may be included excesses of all kinds; and eighth, infectious diseases.

There is a widespread belief, based upon the experience and statements of trustworthy observers, who have had such experience with nervous diseases due to syphilis that their opinions are entitled to great weight, that syphilitic diseases of the nervous system are much more likely to occur in individuals who give a history of mild syphilitic infection, manifested by local and constitutional effect. They base their con-

viction not alone upon the histories of patients, but upon the statements of syphilologists. It is generally admitted by neurologists that the majority of patients who come under treatment for syphilis of the nervous system do not show, in external tissue or feature, signs or indications of the previous existence of the disease. It is easy, however, to be misled into drawing wrong inferences from such experience, for, bearing in mind what has been said concerning the time of occurrence of the majority of syphilitic nervous diseases, it will readily be seen that involvement of the nervous system occurs before the period when cutaneous, ocular, osseous, and membranous manifestations of the disease may take place.

There is a firm and apparently undislodgeable belief on the part of most physicians that the most influential factor in the occurrence of genuine syphilitic diseases of the nervous system is improper, insufficient, and incomplete antisyphilitic treatment. This belief is largely the result of the teachings of syphilologists, and partly of the experience of general practitioners and neurologists. Despite this widespread belief, partly based on tradition and partly on experience, there would seem to be a conviction on the part of some, perhaps many, of which the writer is one, that the influence of antisyphilitic treatment, even when carried out in the most orthodox and approved way, is not so potent a measure in the prevention of true syphilitic nervous disease as it is generally believed to be. This should not be construed to mean that the incumbency is any the less great on the part of the physician to treat his syphilitic patient along the most approved lines and in the most thorough and systematic manner. The reason for the insufficiency of antisyphilitic medication we shall speak of when discussing treatment. It is merely the statement of a fact which seems to be supported by statistics. Concerning the efficiency of treatment in the prevention of parasyphilitic nervous disease, we may speak with much more positiveness. My own belief is that antisyphilitic treatment has little if any influence to prevent the occurrence of parasyphilitic disease of the nervous system. This opinion is based upon most careful study of all the cases of parasyphilitic nervous disease that have come under my direct personal observation in hospital, dispensary, and private practice during the last ten years. Starting with the firmest belief that antisyphilitic treatment was the most powerful influence in the prevention of parasyphilitic nervous disease, I have been compelled against my will and inclination to the acceptation of the facts as stated above.

Syphilitic infection is comparatively a rare condition after the fortieth year, and consequently experience or statistics on which one may found a belief concerning the influence of age on the occurrence of syphilitic disease of the nervous system is limited. It is generally conceded that individuals who acquire syphilis after this period are much more liable to the occurrence of syphilitic affections of the nervous system than those

who become infected earlier in life. My own experience is in fullest accord with this view. There is by no means unanimity on the part of neurologists concerning this, however, and some recent investigators have contended that it is not true. Like some other opinions in syphilography, it may depend largely on tradition, but until further proofs of its falsity are forthcoming it must be accepted.

Statistically it is not difficult to show that persons who have had uncommon avenues of infection, extragenital chancres, develop affection of the nervous system oftener and earlier than those in whom the chancre has been of customary location. It may be that the currency of this view is due to the fact that such lesions are oftener unrecognized and untreated, although, of course, it is appreciated that this statement is out of harmony with what has been said concerning the influence of treatment on the occurrence of syphilitic disease of the nervous system. The fact that the syphilitic virus enters the system through an abrasion around which develops a soft chancre has already been mentioned. To again revert to this subject would be only to reiterate what has been said.

Under the heading of the fifth predisposing cause, of individual peculiarity or constitutional idiosyncrasy, but little can be said, aside from the fact that an inherited neuropathic constitution and acquired states of nervous exhaustion seem to predispose to both the genuinely syphilitic and parasyphilitic disease.

The frequency with which slight and severe trauma to the head and to the spine, profound physical exhaustion, and exposure to cold, which act principally upon the spinal cord, precede the development of manifestation of syphilitic disease of the nervous system justifies the belief that these are important factors. In the summer of 1898, I saw two cases of syphilitic spinal paralysis in one regiment of the National Guard develop apparently as the result of the exhausting effect of prolonged drilling and manœuvering to which they as sedentary men had been unaccustomed. No other cause, such as exposure to wet or cold, could be postulated. One of the patients had had the initial lesion a year previously; the other four years. Both of them had been under continuous treatment. Trauma facilitates the occurrence of syphilitic involvement of the nervous system by causing more or less local depreciation of circulation and nutrition, which gives the syphilitic poison an opportunity to manifest its sinister activity in some segment or tissue of the nervous system.

Perhaps the most important factor in predisposing to syphilitic disease of the nervous system or the most vicious antecedent condition may be included under habits, customs, and excesses. Of these, by far the most important are excesses of alcohol and tobacco. The depreciation of vitality and nutrition attending the intemperate ingestion of alcohol and its tendency to cause parenchymatous degeneration coincident with connective-tissue increase all over the body make it the most baneful predis-

posing cause of syphilitic disease of the neural parenchyma. Tobacco exercises its pernicious influence mainly through depressing the circulation. In a much smaller number of cases sexual excess seems to play some rôle, especially in causing disease of the spinal cord. Exhausting mental or physical work, and particularly both combined, enervating habits and indulgences, worry, fright, and anxiety, some one or all of them, often form a conspicuous feature of the period elapsing between initial infection and the occurrence of involvement of the nervous system. It is easy to understand how and why they exercise a pernicious influence. These factors seem to be as potent in predisposing to the occurrence of ordinary syphilitic nervous disease as they are to parasyphilitic disease. The greater liability of the male sex to these explains in a measure the more common occurrence of syphilitic nervous disease in men than in women, although it still leaves a great hiatus in attempting this explanation.

The rôle played by infectious diseases, such as malaria, typhoid fever, dysentery, pneumonia, and the like, in predisposing to involvement of the nervous system by the syphilitic virus is much greater than one might infer from a study of the writings on this subject. Indeed, very few of them refer to it at all. Yet in my own experience they play a not infrequent and unimportant rôle. It is particularly in predisposing to the occurrence of syphilitic disease of the blood-vessels that they have their most conspicuous effect.

A word must be said concerning the diseases of the nervous system due to congenital and so-called hereditary syphilis. Congenital syphilis may produce the same syphilitic and parasyphilitic diseases as acquired syphilis, and these diseases may show themselves at any time from before birth until after puberty. Like the acquired nervous diseases due to syphilis, they are predisposed to occur comparatively soon after infection. A considerable proportion of the infantile cerebral palsies, of idiocy, and of lesions of the nervous system associated with marasmus, are due to congenital syphilis. Statistics seem to show that the majority of cases of general syphilis of an exudative nature occur between the fifth and the tenth years. The *modus operandi* of congenital syphilis in producing disease of the nervous system is the same as that of acquired syphilis. The only differences are those which are determined by the immaturity of the nervous system upon which the virus and the toxins act in the former case. The term hereditary syphilis has fortunately begun to disappear from the literature as the result of the general acceptance of the belief that syphilis is dependent upon a specific infection. Naturally, it is absurd to speak of an infectious disease as hereditary, inasmuch as the development of any characteristic properly designated as inherited is due to structural modification of the germ plasm of the parent.

Intoxication and Nervous Disease.—The relationship of intoxication

to the occurrence of nervous disease is extremely important. It is often difficult to discriminate intoxications from infections. Intoxicants of the nervous system include poisons taken in from without the system, or exogenous poisons; and poisons having their origin within the system, or endogenous poisons. It has already been said that autointoxication is frequently the result of the existence of the infectious diseases. The vast majority of poisons of external origin act injuriously upon the peripheral nerves to cause inflammation or degeneration, or upon the nutrition of the different components of the cerebrospinal and sympathetic systems to produce disturbance of nutritional equilibrium which constitutes functional disease. Thus alcohol, lead, arsenic, phosphorus, bisulphide of carbon, and the vegetable alkaloids, such as those of opium, tea, tobacco, cacao, and the like, play a most important rôle in the causation of multiple neuritis and such functional nervous diseases as neurasthenia and hysteria. None of these substances has as yet been shown to stand in direct relationship to organic disease of the central nervous system except in so far as they lead to vascular degeneration by perverting the function of the sympathetic nervous system. It is not at all improbable that the way in which intoxicants in common use, articles of diet and luxury, such as tea, coffee, tobacco, and alcoholic drinks, act to produce nervous disease is by bringing about a general disorder of nutrition which is presided over by the sympathetic nervous system. This leads directly and indirectly to neurasthenia, epilepsy, hysteria, and vasomotor disorder such an angeioneurotic œdema. The individual may, by predisposition of heredity or acquirement, tend toward the development of one or the other functional disorders.

The Effects of Stimulants and Narcotics.—As there is a group of causes which pass from infections into intoxications without a clear distinction being possible between the two, so we pass from the intoxicants as causes of nervous disease to such social habits as might be classified as intoxications, persisted in until they finally initiate degeneration. I refer to the indulgence in alcohol, tobacco, tea, coffee, morphine, cocaine, chloral, and other narcotics. Alcohol in particular is a very frequent cause of nervous disease. Clinically and experimentally it has been shown to be often the sole cause of inflammation of the nerves, acute degeneration of the neural parenchyma, and decay of the blood-vessels. Alcohol taken in small quantities is unquestionably a food and is disposed of in the system to the advantage of the general economy. It is not with the effects of alcohol in such quantities that we are here concerned. It has been contended by many that alcohol and the narcotics are injurious no matter how temperately they may be used. That this is not so is sufficiently attested by the social history of the most advanced peoples in whom the use of alcohol, tobacco, tea, and coffee is universal. That the excessive use of any of the above-named narcotics

is injurious, and that the effects are often most calamitous to mental and physical integrity no one can deny. All of the narcotics taken in any quantity are injurious to the normal individual before complete maturity. After maturity the moderate use of tobacco, alcohol, tea, and coffee is not only devoid of injurious capacity to the individual, but it may assist him in the enjoyment of life and the performance of his duties without in the least jeopardizing health or impairing physical or mental vigor. To this rule there are certainly exceptions. There are those who cannot take any of these substances without in a measure making it more difficult to maintain the balance between health and disease. Such exceptions are constituted in the main by those who have inherited or acquired the neuropathic diathesis. It may truthfully be said that the use of stimulants and narcotics by those who are of the neuropathic constitution is injurious. Many of this class, however, may at times with advantage use these substances temporarily for their stimulating or sedating effects, and for the aid which they lend to the establishment or maintenance of the general nutrition. Further than this it is impossible to generalize. When it becomes necessary to decide whether or not the temperate use of any or all of these is injurious to a given individual, the safest way to determine is by trial. If the moderate use of tea, coffee, tobacco, or alcohol causes toxic symptoms, be they ever so slight, it is injurious and should be stopped. The individual may be assured that their continued use will surely work mischief. It must be said, however, that many individuals who would otherwise be unable to indulge in the use of these luxuries without jeopardy to their health may, by strict conformation to the laws of general hygiene, use them temperately without injury. The individual equation is very important and must be constantly taken into consideration. One man may consume a quantity of tobacco or of alcoholic stimulant during the span of an entire lifetime which would be most disastrous to another. The latter may regret his limitations because of the conviction that it increases life's handicap, but he must be taught to look upon compulsory abstention as a virtue, or he may if he chooses consider it an individual infirmity. It really matters not how he interprets it so long as he can be made to realize that such indulgence is inimical to the maintenance of health.

The Rôle of Autointoxication.—The influence of autointoxication upon nervous disease has within the past ten or twenty years called forth a large amount of research. It still offers a fruitful field for investigation, as the question of how important a part poisons generated within the system play in the causation of functional and organic nervous diseases has by no means been satisfactorily answered. Indeed, at the present time we are unable to say that any organic disease of the central nervous system is caused wholly by such intoxication, save possibly sclerosis of the posterior columns of the cord occurring with pernicious

anæmia. The difficulty of determining exactly the influence which the autointoxicants have in causing functional and organic nervous disease is enormously added to by the fact that all such diseases are attended from the very beginning by disturbance of metabolism which allows not only the production of these intoxications but facilitates their activity. Certain it is, as we shall have occasion to say later on, that treatment directed wholly to counteracting autointoxication in certain diseases, such as neurasthenia, epilepsy, hysteria, the vasoneuroses, and other functional nervous and mental diseases is often so beneficial that the most sceptical become convinced that a close relationship exists between autointoxications and the occurrence of these diseases. This is nowhere better shown than in the treatment of epilepsy. Strict attention to the condition of the avenues of reconstruction and elimination, combined with careful supervision of the diet, is often attended by as beneficial influence on the phenomena of the disease as is the most elaborate therapy.

The manner in which diseases dependent upon defective metabolism, such as gout, rheumatism, diabetes, and the like, produce disease of the peripheral and central nervous system cannot always be explained otherwise than by reference to the resultant depreciation of nutrition in certain parts or tissues of the nervous system. There are many reasons for believing, as has already been suggested, that these diseases themselves are frequently, if not always, immediately conditioned by perverted functions of the sympathetic nervous system, although they may be otherwise remotely caused. The loss of metabolic balance which they represent and the dissociation in the components of the blood with which they are accompanied are the result of glandular and metabolic functional disturbances which are under the immediate control of the sympathetic nervous system. When these diathetic conditions or diseases cause disturbance of function in the general cerebrospinal sphere, manifested by functional disease or by more profound organic disease, a pernicious circle is formed around the nervous system. The diathesis is merely an arc, causative on the one hand, caused on the other.

Trauma as a Cause of Nervous Disease.—The part played by physical trauma in the production of nervous disease is generally admitted though often insufficiently emphasized. In recent times the causal relationship subsisting between bodily injury and the occurrence of neurasthenia and hysteria has given rise to a new class of diseases, the traumatic neuroses. General paresis is sometimes caused by trauma, and the development of brain tumor after injury to the head cannot be gainsaid. Trauma of one kind and another is very common in children; happily it is usually without ulterior results. But it has been shown conclusively that serous meningitis and acute non-hemorrhagic encephalitis, both in the child and in the adult, are sometimes due to trauma. Remotely antecedent trauma

must not be allowed too great importance in estimating its etiological influence in nervous disease unless the trauma be repeated. Repeated slight blows are not infrequently a part of the patient's previous history in general paresis. No one can deny the capacity of persistent slight trauma, such as the vibrations and agitations to which railway engineers and others are liable, to produce functional nervous diseases such as neurasthenia and hysteria, especially in neuropathic individuals.

The relationship of occupation or calling to the occurrence of nervous disease is of no particular importance save as it exposes the individual to the causes and influences which we have already pointed out are injurious to the nervous system. In discussing individual diseases, we shall have occasion to speak of the occurrence of progressive muscular atrophy in artisans, such as gold-beaters and embroiderers; of neuritis in workers with lead, arsenic, and bisulphide of carbon; of glosso-labio-laryngeal paralysis in cornet-players and glass-blowers; of neurasthenia in professional men; of the constantly increasing class of professional neuroses: all of these, and others that might be enumerated, act in the production of nervous diseases by the employment of agencies and conditions which we have already considered.

Psychical Trauma.—Important as physical trauma has been shown to be in the initiation of disease of the nervous system, it is by no means so potent for mischief as are the mental traumata. Under this latter term are included fright, worry, grief, emotional exaltation, protracted mental activity, excessive social and pedagogical stimulation or its opposite, ennui and idleness, and also perverted and excessive activity of the sexual functions.

The shock due to fright or other sudden and excessive emotion is believed to exert its pernicious influence by causing a varying degree of functional overthrow of the sympathetic nervous system. This derangement of the sympathetic nervous system produces not only many of the immediate subjective and objective phenomena of shock, but also remote consequences, which appear as disorder in the nutrition of the cells of the cerebrospinal system. When the nutrition of these cells becomes incapable of recouping the losses of the cell due to its functional exercise, cell fatigue and finally disease are initiated. Upon the mental and physical disposition and temperament of the subject, quite as much as upon the cells affected, will depend the clinical features of such resultant disease. They may be predominantly psychical, presenting a retrograde dissociation of the mental components of memory and ideation, or they may show themselves in a loss of inhibition, in inefficiency of execution, or in the total impairment of certain special functions, as in hysterical amblyopia and aphonia.

The other factors that we have named under the caption of psychical trauma operate to produce functional nervous disease and to predispose

to organic disease in the same manner as does shock. Their immediate effects are disturbances of cell metabolism, and to some extent of the general metabolism of the entire body. Thus are to be explained the effects of grief, worry, and protracted emotionalism, as these are manifested in loss of strength and health, with the attendant physical weakness accompanied by depreciation of mental vigor, excessive emotionalism, fixed ideas, melancholia, and hypochondriasis.

Relationship to the Epoch.—The impression seems as strong in the opinions of the laity as in the minds of many physicians that the frequency of nervous disorder is a sign of the times, demonstrating that we are living in a world whose bustle and hurry inevitably tend to the production of functional and organic nervous disease. While there is probably more truth than error in this conviction, there is yet a sufficient amount of error to prevent an unqualified subscription to its terms and consequences. Functional and organic nervous diseases are relatively more frequent to-day because they are more readily detected and their pathogeny is better understood. But the fact that neurasthenia has been known only to the present generation should not be construed to mean that it did not exist before the time of Beard, nor is one justified in the belief that tabes dorsalis did not exist before the time of Duchenne. Neurasthenia was the legitimate successor of the same exciting causes a thousand years ago as it is to-day, and tabes dorsalis, like the English common law, has its sources in a period preceding the knowledge or memory of man. The increase of wealth and the greater intensity of the struggle for existence have augmented the labors, the dissipations, and the idleness of men. The growth of large cities curtails the amount of physical exercise in young and old, while increased facility of education makes the burden of the growing organism a difficult if not a dangerous one.

Work and Nervous Disease.—It is impossible to say in so many words what constitutes the limit of work or indulgence that each must set for himself with due regard for his own safety. Individualization is more significant for the just appreciation of the combination of the factors that determine the onset of nervous disease than it is for the understanding of the causation of any other of the bodily ills to which some are susceptible while others appear exempt. Certain it is that no human being can exceed the measure of his physical and mental strength with impunity. To borrow from rest and sleep and the other factors of reconstruction is to lend to disease and death.

Sexual Influences.—Before taking leave of the psychical factors that are operative in the causation of nervous diseases, it will be necessary to give some consideration of the influence of the functions of the sexual sphere upon the neural economy. I shall have occasion to speak of the relationship of excessive and perverted sexual indulgence to certain par-

ticular diseases of the nervous system when speaking of the special treatment of neurasthenia, hysteria, and locomotor ataxia. I am led to the present consideration because of the existence amongst the laity of a well-fixed conviction that unnatural sexual practices, as well as excessive natural indulgence, are extremely injurious and frequently the cause of profound disease. This conviction has been engendered to a certain extent by physicians, and there are those who still contend for its substantial justification. Doubtless the early arousal of the sexual function, especially before the period of adolescence, and its unnatural indulgence, particularly in onanism, enter largely into the etiology of such functional diseases as neurasthenia. The mere physical act of onanism, however, is not the most potent etiological factor. Indeed, if this were all that perverted sexual gratification involved, the history of such sexual indulgences would seldom present nervous symptoms. The mental factors are much more potent for harm, and these are more likely to be augmented than allayed by intemperate and unwarranted advisers. Too often the terrorizing admonitions of well-meaning but ill-adapted teachers or parents, the ghastly literature that worms its pernicious way into the hands of school boys and young men, wherein is portrayed by word and picture the physical decay and mental agony that have followed such practices in their predecessors, are more harmful to the mental and physical economy than the mere indulgence itself.

If we set aside our own moral and æsthetic prejudices, it seems indeed difficult to believe that occasional masturbation should in and of itself be any more harmful than other forms of sexual indulgence. The individual who has passed the age of puberty with the common sentiments of a civilized community may be expected to consider onanism disgraceful, fifthy, and injurious. He probably also regards illicit sexual intercourse as both sinful and dangerous. The motives which lead him to self-pollution may be numerous. He may intend neither to masturbate nor to indulge in sexual intercourse, but falls a victim by the wayside to temptation, offending his own inherited and moral sense. He feels himself walking about among his fellows with a feature of his life which he must conceal, an object which all men would despise could they know, a whited sepulchre full of unholy desires. Small wonder if the consciousness of himself as a monster of evil should lead to emotional depression and consequent disturbance of metabolic equilibrium. On the other hand, he may indulge in masturbation because he regards illicit sexual intercourse a greater evil or because he is over-shy and modest with the other sex, or fears the moral, social, and personal consequences. Whether he yields to fear or other motives, he is likely to heap reproaches upon himself because of his unfortunate situation. Of course, it is quite possible that he may arrive intellectually at the conclusion that there is nothing wrong in onanism, and he may convince himself that he may indulge in it with

impunity. Though he give himself no moral offence, and suffer no remorse, yet his inherited and acquired moral nature will revolt, perhaps unknown to himself, at the action which his intellectual consciousness justifies.

Another consideration not to be overlooked is that the vast majority of boys who indulge in this practice cease to do so before it can possibly have done them any harm; but among those who have entirely given over such practices the aforesaid terrorizing warnings of the teacher, the quack, and the physician are not infrequently operative, and they nurse though they conceal the fear that they have through past error laid the foundation of serious disease. It is incumbent upon the physician to pluck from the minds of those who have been so improperly oriented the thorn which remains in the shape of terror that such indulgence is a permanent source of injury and the cause of many nervous diseases. This is not to maintain that masturbation is harmless to the physical and mental welfare of the individual. The sexual function is intimately associated with the higher as well as the lower nature of man. The appeasement of the sexual emotion which the psycho-physical organism demands cannot be obtained unless sexual erethism be the resultant of a manifold appeal to the intellectual, moral, and æsthetic factors, and not restricted as in masturbation to the dermal sense and dermal stimulation alone. The physician should be keenly alive to the fact that the great majority of those who continue to practise masturbation or other perverted sexual indulgence after they have apprized themselves or been made aware of its vileness and loathsomeness are mentally and physically pathological. In the presence of disease which the patient or the laity may be convinced stands in relationship to such indulgence, the physician must be on his guard, however, lest he mistakenly confound cause and effect.

The physician is often called upon to advise in cases in which the choice seems to be between a doubtfully serviceable sexual indulgence and the effects of continence. Man is endowed with a sexual function which makes greater demand upon the organism for its physiological exercise than does almost any other function of the body. To restrain it to the point of abnegation calls for an amount of inhibition that is injurious to some, even though these be rare cases. A very firm conviction prevails in the minds of many physicians as well as of the laity that the human being, particularly the male, requires for the preservation of his physiological well-being an amount of sexual intercourse that is measured by the sexual energy of the individual. This belief is fostered by an appeal to the naturalness of sexual intercourse and to the consequences that are supposed likely to follow upon any interference with or cessation of nature's laws. The belief is entirely unwarranted, and no physician need hesitate to enjoin or to recommend continence because of possible injury to the nervous system. Nor need he feel called upon to offend the

mora. sense of the community by advising sexual intercourse in cases in which it cannot be procured under the recognized forms of society. The physician whose advice is sought in such situation can only lay the *pros* and *cons* of the situation in an impartial way before the patient, permitting him to be the arbiter of his own sexual destiny.

In the sexual life of the female there are two very important periods, sexual maturity and the cessation of reproduction, both of which deserve mention here. Menstruation and the functions that it bespeaks are normal physiological functions of the female sex, and were it not for parental ignorance and willingness to sacrifice daughters to conventionality, the initiation and continuance of this function would have no depreciating effect upon the vitality of the organism nor contribute in any way to the development of nervous ailments. But errors of diet, dress, hygiene, work, lack of rest, and various indulgences cause this period to play something more than a trifling part as a causative agency in the production of what are sometimes permanent affections of the nervous system. At no time after the birth of a child is the intelligent care of a well-instructed mother more necessary or the lack of it more startlingly frequent than in the years immediately preceding the period of sexual maturity in the girl. Not the body alone requires more than usual care: the mind as well is in a state of irritability and experiencing changes of emotion and thought for which all possible vitality is needed. It is during these years that a child who possesses a nervous temperament, especially if she be precocious, or introspective, or morbidly conscientious, or not fully robust or able to enter into the sports of her companions, is most sensitive to impressions. She is in consequence apt to be subject to unaccountable outbursts of temper, to spells of despondency and melancholia, to have recourse to excessive indulgence in romantic fancies, to violent attachment and enthusiasms, and to all objects that encourage her morbid sensibility and introspection. Even if the mental, moral, and physical shock of the beginning of menstruation is not a considerable one, her natural development during these most important years frequently takes up much of her vitality and sends her into adult life handicapped with unreal ideals and standards that will make her struggle with the duties before her a severe strain upon her nervous stability. In the same degree to which the child is susceptible to depressing suggestions, to fright, terror, remorse, distress, and revulsion, is she amenable to the beneficent action of the antitheses of these. The mystery which seems to surround her can be so cleared away as to preclude the possibility of shock at least, and she may even be taught to regard her strange vagaries of mind and disposition as weaknesses which can be overcome and will probably be outgrown.

It is particularly at the menopause that nature exacts a penalty for errors of training and living; at this period mental and emotional dis-

turbances are apt to appear in pathological degree. The woman also often finds herself companioned with the ghosts of unattained ambition, and she realizes that the opportunity for achieving them has slipped away. Ideals which have been moral, mental, and physical stimuli have been ruthlessly uprooted, and there is left a soil fertile for the growth of pessimism and despondency. The abrupt awakening to oncoming old age, with its entailment of what so many believe to be unattractiveness, comes to some as the white woman's burden. This period also with its depreciation of physical and mental vitality finds many alone and unprovided for. It is small wonder, then, that the period of the menopause contributes more than its proportion to the ranks of nervous invalids.

Although the woman of the period has the advantage of her sister of a generation ago in that she has successfully forced an entry and maintains a graceful place in the sports and occupations of her brothers, these accomplishments have not brought the development and stability of the nervous system which theoretical advocates of the advanced woman promised. The explanation of this is perhaps to be found in the fact that in proportion as woman has gone in for modern sports and activities she has neglected many duties and occupations that had a wholesome and preservative influence upon the mind as well as the body. She no longer nurses her children nor waits upon her sick. She neither entertains her guests nor directs her household. All these functions she delegates to hirelings. And then she marvels that she has *Weltschmerz*, and attacks of nerves. Improved educational facilities and enlarged spheres of activity cannot accomplish their meed of benefit to the woman or the race, if these are attained at the expense of duties for which her psycho-physical organism is adapted.

CHAPTER II.

THE PREVENTION OF DISEASES OF THE NERVOUS SYSTEM.

The general practitioner has no more important or difficult duty than to exercise the requisite skill and to employ adequate measures to prevent diseases of the nervous system. The fact that functional and anatomical restitution of the central nervous system is but seldom attainable after its components have been subjected to degenerative influences, makes the demand upon the physician imperative to prevent, if possible, and at least to cut short, the course of these degenerative processes. The prophylaxis of nervous disease is beset with obstacles that in some cases are insurmountable. The majority of patients come within the ken of the neurologist after the functional or organic diseases from which they suffer have ceased to be amenable to causal therapy. Although the factors upon which the existence of the disease is dependent have perhaps ceased to exert their baneful influence, they have nevertheless already done all the mischief that lay within their power. The period within which causal therapy could have been efficaciously employed may thus have long since passed. For example, anterior poliomyelitis is generally seen by the neurologist only after the acute infection or intoxication from which it took its origin has ceased to exist. The patient suffering from alcoholic multiple neuritis has as a rule stopped or moderated his bibulous habits before he consults the specialist. The same cessation of the exciting cause is frequently determinable, in cases of neurasthenia due to overwork, of hysteria traceable to psychical trauma, and in a considerable number of other diseases. It is therefore beyond the capabilities of the neurologist personally to live up to the requirements of the first principles of therapeutics, which requires that the cause of disease be ascertained and removed. The general practitioner, however, is often consulted for some trifling ailment which he readily recognizes as the product of overwork or other injurious excess. He should also understand that these agencies, unless interdicted, will surely lead to that profound depravity of the nervous system known as neurasthenia. An intimate acquaintance with the causal dependence of nervous disease upon many of the simple and profound ailments which he so frequently treats will enable him in many cases to avert their pathogenic activity. Many exceptions are of course found to the rule that causal therapy is not indicated in fully developed disease of the nervous system, as may be seen in the several pages

devoted to the consideration of the treatment of the various specific diseases.

The family physician has many opportunities to play a very significant part in the prevention of nervous diseases. So many of the general diseases which come under his immediate observation have a momentous direct and indirect bearing upon the etiology of nervous diseases that, if gifted with ordinary foresight and the ability to interpret the phenomena of disease, he may forestall the development of diseases of the nervous system whose beginnings are indicated to his trained eye by very trivial symptoms. The neurologist who aspires to compete with the general practitioner in this rôle must be learned and experienced beyond his specialty in general medicine and pathology. The early recognition of encephalitis would prevent, at least in part, many cases of idiocy, epilepsy, and other mental diseases dependent upon or associated with post-encephalitic lesion. Such symptoms also as convulsions, pavor nocturnus, and somnambulism in children oftentimes give evidence of an unstable nervous system and bespeak the necessity of rigorous hygienic and mental discipline. He who would successfully insure his patient a life free from nervous disorder must lose no time and spare no effort to counteract the effects of infections, intoxications, traumata, and the like. The syphilologist particularly should recognize that the treatment of syphilis recommended and practised to-day is far from efficient when judged by the standard of the neurologist. It can scarcely be denied that the requirements of a complete cure have not been attained so long as locomotor ataxia and general paresis continue to occur as frequently in those who receive full and orthodox antisyphilitic treatment as in those who receive no such treatment.

The Prevention of Hereditary and Familiary Factors.—In the preceding chapter I distinguish the hereditary and congenital conditions which, together with the neuropathic diathesis, furnish a rich soil upon which nervous diseases develop from infections, intoxications, and from physical and psychical trauma. Many diseases of the nervous system are thus dependent upon conditions that prevail before the patient's birth. The number of those diseases which comprise the classes known as hereditary and familiary diseases is yearly increased as progress is made in the interpretation and understanding of the laws of heredity. The nature and origin of these diseases call for prophylactic and indeed curative treatment that must be begun before conception. This, of course, does not mean that treatment should not be carried on during the lifetime of the individual thus afflicted, but an efficient prophylaxis of familiary and hereditary diseases necessitates a discussion of such questions as the interdiction of marriage, the cessation of procreation, and the bringing up of children. These are topics which in a measure lie beyond the province of the physician; but the family physician at least may be ex-

pected to have an insight into the social and hygienic environment of his patients, and perhaps also a knowledge of their hereditary shortcomings and afflictions. This being so, he is particularly charged with the prevention of hereditary nervous diseases. The quality of his advice will depend not only upon his professional knowledge, but also in large part upon the ethical and social standards to which he refers his conduct. The specialist whose counsel may be sought in such cases is able to take a more unequivocal stand than the general practitioner, because he is expected to have a more authoritative acquaintance with the genesis and outcome of diseases of a family and hereditary type. To the best of their respective abilities and opportunities they should unite to discourage marriage of the unfit. This class comprises all those whose mental and physical shortcomings are calculated to produce in offspring traits and possessions that will render them unfit to bear the burdens of life and meet the requirements of modern civilization.

There are many family and hereditary diseases, such as amaurotic family idiocy, congenital spastic diplegia, progressive muscular dystrophy, for whose prevention no other means have been suggested save the radical measure of surcession of procreation. No one will be likely to contend that this measure is not wholesome and legitimate, however difficult it may be of adoption. Some of the hereditary diseases, however, do not come within this category. For example, migraine is exquisitely an hereditary disorder, and yet few physicians would care to advocate the celibacy or childlessness of the migrainous. Then, again, there are family diseases such as Huntington's or degenerative chorea which do not manifest themselves until the advent of physiological senility. Before one is justified in advising against the production of offspring for persons whose heritage is freighted with the burden of this awful disease, he must first convince himself that he is not refusing birthright to an Isaiah, a Napoleon, or a Shelley, all of whom earned their laurel leaves before their fortieth year. Again, some of those afflicted with the strange family disease myotonia congenita are endowed with exceptional mental qualities, which may be accepted as offsetting the pathological burden of this disease. When the physician's advice is sought in regard to the question of the propriety of giving birth to offspring in such inherited or acquired nervous diseases as epilepsy, hysteria, hypochondria, and so forth, no hard-and-fast rule can be laid down. Whether or not such persons should allow themselves the luxury of progeny is a question that they must decide for themselves after they have been fully warned of the danger of bringing children into the world likely to become a burden to themselves and to the community. The neuropathic diathesis or even a profoundly neurotic parentage does not, unless other obstacles appear, suffice to justify advising against procreation. The sins of parents must be paid in so many ways that it is far too much to require that any one shall live a life of celibacy

or of childless matrimony because he himself suffers from neuropathic hereditary entailments.

The Prevention of the Influence of Infection, Particularly Syphilis.—The momentous rôle of infection in the causation of diseases of the nervous system calls for general and specific measures to prevent the nervous system becoming subject to pathogenic processes, either directly from infection or indirectly in consequence of the development of toxins resultant upon infection. Malaria, influenza, pneumonia, syphilis, typhoid fever, scarlet fever, measles, diphtheria, all act directly upon the nervous system or render it susceptible to autointoxication. So imperative is the demand upon the practitioner of medicine and the practical hygienist to exercise thoroughgoing prophylactic measures that I shall be compelled to direct particular attention to the details as well as to the general features of preventive treatment. Of these infections, syphilis has been chosen for most extensive consideration, because no other source of infection known to the neurologist acts with such frequency and with such pathogenic virulence. Although this fact is often enough emphasized by the neurologist, it has not yet produced the impression upon the minds of the general practitioner and syphilologist that it deserves. The general scope of the prophylactic treatment of nervous diseases due to syphilitic and post-syphilitic infection is such that extensive consideration of the treatment to be accorded other infectious sources will be unnecessary.

The prevention of syphilis is in reality the avoidance of promiscuous sexual intercourse. Syphilis of the innocent comprises such a small proportion that it can be neglected. The treatment of syphilitic disease of the nervous system (and here only the genuine syphilitic varieties are intended, as the parasyphilitic diseases are in no way amenable to antisyphilitic medication) might be dismissed with a line: maintain the vitality and increase the nutrition while pushing vigorously antisyphilitic medication—mercury and the iodides. Although such are the indications, and although to encompass such results the physician must bend his most strenuous efforts, the matter is of such vast importance that it must be considered in more detail. It may be platitudinous and commonplace to revert to the prophylactic treatment, but until the family physician becomes imbued with the fact that he owes to himself and to those who rightfully look to him for instruction and orientation concerning the avoidance of diseases the duty of bringing forcefully to their cognizance the widespread dissemination of a disease, syphilis, that is more potent in the production of misery and the entailment of suffering than any other preventable disease, such truisms and platitudes must continue to be spoken by those who appreciate the enormity of this scourge and the force that it makes for mischief. No one can have had much experience with syphilitic diseases of the nervous system without

being soon convinced that unfortunately it is not he who indulges in riotous living and gives himself over to debauchery that becomes infected with syphilis so frequently as it is the innocent, uninitiated youth. Too much emphasis cannot be laid upon the warning given by a person of authority, such as the family physician should be, that the jeopardy in which such indulgence places the person's life, health, and capacity for usefulness and enjoyment is comparable to no other experience which he can possibly have in every-day life.

The Influence of Antisyphilitic Treatment.—Once the individual has become infected with syphilis, there is no treatment that will absolutely assure him that the nervous system (the blood-vessels, the parenchyma, or the coverings) may not become diseased. There is much that can be done by way of diminishing the risk of such involvement of the nervous system. Due appreciation of this and the avoidance of factors that have been pointed out as conducive to the occurrence of syphilis of the nervous system constitute what may be termed the prophylactic treatment. The most important measure for the prevention of implication of the nervous system is thorough and prolonged administration of mercury and iodide of potassium. It seems necessary to make this unqualified statement before proceeding farther, in view of the fact that I must revert to the innumerable instances in which conformation to this practice fails to give anything approaching immunity to the nervous system. Although such treatment has little or no capacity to prevent the parasyphilitic diseases of the nervous system, it can be justly maintained that it does much to prevent and to overcome the exudative or true syphilitic lesions of the nervous system, the same as it does similar lesions of other parts of the body. Yet that it does not accomplish this end with the certainty that syphilographers the world over would have us believe is known to every neurologist. And the perniciousness of the teachings of such syphilographers is so great that it is necessary to revert to the matter at some length in this connection. It is one of the commonest experiences to read in medical journals and books, or to hear in the discussions at medical societies from the pens or lips of prominent syphilologists that syphilis is an eminently curable disease. Such statements are apparently substantiated by convincing statistics, and few will deny that those who disseminate them are entirely convinced of the righteousness and tenability of their position. Yet we who see phases of syphilitic disease entirely different from the manifestation of it in superficial tissues which forms the preponderant bulk of the syphilologists' practice know that they are wretchedly in error. It is a duty of the neurologist to counteract the banefulness of such teaching, and to point out to the syphilologist the error of his way. At least one-half of the cases that come under treatment for genuine syphilitic disease of the nervous system have been subjected to what is

considered the most approved plan of antisyphilitic treatment. It is not difficult to show that the dictum which has received such wide dissemination and acceptation, viz., that involvement of the nervous system is a late or tertiary manifestation of syphilis, has stood in the way of a proper conception and utilization of the preventive treatment of intraspinal and intracranial syphilis. As a matter of fact, the distention of the perivascular spaces with small round cells and a formation of a coat-sleeve-like sheath around the vessels of the meninges or of the parenchyma of the nervous system are oftentimes among the earliest constitutional manifestations of syphilis. They may indeed be contemporaneous with the development of cutaneous and mucous-membrane affections usually spoken of as secondary. The majority of syphilographers contend that the constitutional treatment of syphilis should be delayed until the appearance of "secondaries," and if this plan is followed, it is easy to understand that the orthodox treatment of syphilis does not prevent what is ordinarily called syphilis of the nervous system. This statement should not be construed to mean that antisyphilitic treatment is not capable of curing syphilitic disease of the nervous system. As a matter of fact, unless the lesion be of such severity that it causes the death of a component of the nervous system, such treatment fortunately is at times sufficient to effect a cure. The fact that antisyphilitic treatment is not so successful in curing syphilitic disease of the nervous system as it is in curing syphilitic diseases of other tissues of the body is explainable on the ground that tissues having highly developed functions do not tolerate so much structural encroachment as do those that are structurally and functionally less highly developed.

The Time and Mode of Administering Antisyphilitics.—This leads us to a few remarks concerning the time when antisyphilitic treatment should be begun, the plan which should be followed in carrying it out, and the duration of such treatment. Naturally, this is not the place to consider this matter in great detail, nor does the writer feel that his words should be given any weight save as an expression of conviction based on personal experience, which is small compared with that of many systematic writers on the subject. Nevertheless, it is experience that has been gained in the treatment of syphilitic lesions of the human body encountered in general and neurological practice. As the point of view of such an one is quite different from that of the syphilologist, and as his is the vantage-ground, these may entitle him to a hearing. Granted what has been said above concerning the temporal relationship of syphilis of the nervous system, it must be readily seen that the urgency is to begin antisyphilitic medication at the earliest possible moment, if the object is to spare the nervous system. This does not mean that antisyphilitic treatment should be begun on the day when the initial lesion is discovered, unless it be that one can then convince

himself of the real nature of the initial lesion. Syphilologists say that it is useless to begin treatment at such a time because the system is not yet infected and because antisyphilitic medication gives no immunity to the cells which must battle with the syphilitic virus as soon as the poison is absorbed into the system. In the same breath, many of them say that one of the most cogent reasons for delaying antisyphilitic medication is that we may not obscure the diagnostic worth of the secondary manifestations. Then we are asked to believe that there is no discrepancy in these two statements. If antisyphilitic medication has no virus to act upon, how can it in any way prevent the appearance of secondary manifestations? Any one can see that there is a tacit admission on the part of such writers that antisyphilitic medication does prevent such "secondaries," and just in so far as it does, it tends to attenuate the syphilitic virus and make syphilis a more curable disease. Another objection to early medication, so puerile that it scarcely needs consideration, is that such medication uses up the receptivity of the gastro-intestinal tract for the reception and absorption of mercury. Granted that there be a grain of truth in this objection, may we ask, Is the receptivity of other avenues also exhausted? The time to begin antisyphilitic medication is when the diagnosis can be made. This rule holds good in the treatment of all diseases. If we were discussing the measures that should be adopted to grant immunity to syphilis, then we might speak of the administration of a syphilitic serum or antitoxin. But until such a substance is discovered we must speak of the utilization of measures that are at hand. Unfortunately, it is often necessary to wait for more pathognomonic manifestations of syphilis than the initial lesion. But it is impossible to beguile us into the belief after the teachings of generations that the initial lesion is not oftentimes absolutely pathognomonic. How little hesitation do we have in putting a patient through a most rigorous and elaborate plan of antisyphilitic treatment when he comes to us with symptoms which we believe, but which we can in no wise prove, are indicative of visceral or vascular syphilis! Then compare such procedure with the abhorrence and studied protestation which many writers on the subject of syphilis manifest against putting a patient under antisyphilitic treatment who has demonstrable but not absolutely pathognomonic lesions of syphilis until they can be corroborated by the appearance of manifestations which even the laity recognize as syphilitic. Of what use is experience and diagnostic insight if we cannot avail ourselves of them for the benefit of our patients? This is the first article in the writer's confession of faith in antisyphilitic medication, and now to pass to the second.

We not infrequently encounter the statement that mercury is the only real antisyphilitic medicament, and that iodide of potassium is an absorbifacient as potent to cause the disappearance of any cellular exudate as a syphilitic one. This no doubt is literally true, but at the same time it

is open to most pernicious and faulty interpretation and application. All syphilologists are in accord in teaching that the early result of the existence within the system of the diffusible poison of syphilitic infection is the production of heterologous new cells. It is to facilitate the removal of these new cells, or to cause integral changes in them that will allow the absorptive fluids of the body to remove them, that iodide of potassium is given. If this is granted, iodide of potassium is not only a real antisyphilitic agency, but it should be given in the earlier course of the disease, not necessarily during the first weeks. The writer's desire is merely to show that the administration of iodide of potassium should not be delayed until the appearance of the so-called tertiary symptoms, or until after two or three years from the time of infection have elapsed.

The mode of administering mercury and iodide of potassium need be but briefly considered, and that for the purpose of making mention of personal preference. The writer has had better results from the use of mercury by inunctions and hypodermatically than from any other procedure. No definite rules concerning the dose of mercury can be laid down that will apply to every case of syphilis of the nervous system. For one patient it may be a drachm of blue ointment rubbed in every day, continued for from four to eight weeks; for another it may be a half ounce, administered for the same time. A youth under the writer's care for meningeal and cortical gummatous deposit, which had failed to improve under mercurial medication by the mouth and skin given in conventional doses, has nearly recovered under the use of one-half an ounce of blue ointment, rubbed into the skin each night at the expense of one hour's time and proportionate energy on the part of a nurse, and three hundred grains of iodide of potassium per diem. The patient has had two courses of forty days each, with an interval of one month between them. Almost as important as the administration of mercury in the treatment of exudative syphilis of the nervous system is the adoption of measures for the maintenance of nutrition and tone of the patient. The results that can be obtained by devoting close attention to the digestive and assimilative organs and to the emunctories are so much better than when these are neglected that they need merely be mentioned. The most assiduous care should be given to building up the patient's general nutrition.

When there exist reasons for the prompt and thorough bringing of the patient under the influence of mercury, the drug should be used hypodermatically. The preferable salts are the bichloride and the tannate of mercury. My individual preference is for the former, as I have not encountered the disagreeable effects from its use, principally pain and localized cellulitis, that are spoken of by most writers. The elected dose should be given in connection with ten times the amount of sodium chloride and injected into the muscles of the hips, not into the subcutaneous fats. Therefore in an adipose individual it is necessary to use a long

needle. If the application proves painful, a small amount of morphine can be injected previously or simultaneously. The patient should be brought under the influence of mercury, but this does not mean that he should be brought to realize either the profound acute or chronic effects of mercurial poisoning. It is not necessary to cause active ptyalism in order to get the effects of the drug, no more is it necessary to give it until it causes great depreciation of nutrition. There are milder symptoms than those of mercurial intoxication, and the appearance of them should be interpreted as a signal that the patient has had for the time being all the mercury that can safely be given. It is injurious to carry the process further, unless the condition of the patient's nutrition can be so improved that more of the drug can be utilized. As a rule, the requisite degree of mercurialization can be brought about in from four to eight weeks, and then the treatment should be entirely interrupted while measures devoted to the tonification of the system are adopted, or the drug should be administered in small quantities during the utilization of the latter.

It is oftentimes advantageous to administer iodide of potassium contemporaneously with the use of mercury, providing that the two together do not too seriously depreciate the patient's nutrition and vitality. If they do, the mercury should be given first in exudative syphilitic nervous disease, while the iodide of potassium should invariably be given precedence when the lesion of the nervous system is of the nature of a granuloma. As a matter of fact, mercury has very little effect in causing disappearance of the latter, although it may have to be given to prevent the further formation of such deposits and increase of size of those already existing. It is impossible to state categorically what the dose of iodide of potassium for different individuals with gummatous formation in the nervous system may be. For one patient the dose may be fifty grains, while for another it may be five hundred. The rule is to begin with a comparatively small dose, say twenty grains three times daily, and increase from five to ten grains each day, depending upon the urgency of the symptoms. It should be borne in mind that in some cases in which the smaller doses, such as half a drachm three times a day, do not have any effect, a dose of one hundred grains or more three times a day is quickly followed by beneficial results. The duration of antisyphilitic treatment given to overcome disease of the nervous system or its coverings will depend largely upon the readiness with which it responds to treatment. It is needless to say that it should be kept up until the symptoms of such involvement have disappeared or until it has been conclusively shown that they are unamenable to treatment. The treatment should be continued in milder form for several months after the cessation of symptoms bespeaking its activity, and the patient should be advised to take a "cure" of six weeks' duration every year for the remainder of his life.

The General Treatment of Syphilis of the Nervous System.—The general treatment of syphilis of the nervous system, aside from the antisyphilitic medication spoken of above, may be summarized in a few words. It is practically the same as the treatment of the depressed types of neurasthenia. Physical and mental fatigue or anything approaching excesses is to be strenuously avoided. The necessity of attention to the reconstructive forces of the system and to the state of the excretory organs and avenues has already been spoken of. An easy life out of doors, with sufficient exercise to keep the body in a state of good physical development, with indulgence in occupations that divert the patient's mind, keeps him from brooding over his ailments and anticipating dire results and has the same usefulness here as it has in neurasthenia. Other cases will be most benefited by putting them through a mild rest plan of treatment, the utilization of simple tonifying hydriatic measures, plain, nourishing diet, etc. The special treatment applicable to each case will depend largely upon the intensity and seat of the lesion. It is not to be supposed that the treatment which would be applicable to a mild degree of pachymeningitis or leptomeningitis of syphilitic origin should be the same as that for syphilitic spinal paralysis or syphilitic endarteritis of any part of the nervous system. In other words, after the administration of the antisyphilitic medication and the measures taken to maintain the nutrition the treatment consists of individualization and the adoption of measures to counteract individual symptoms in different cases.

It is difficult to lay down rules for guidance in the symptomatic treatment of syphilis of the nervous system without particular consideration of each syphilitic disease. For example, the symptom that demands relief most urgently in syphilitic spinal paralysis may be incontinence of urine or fæces; in cortical meningitis it may be attacks of epilepsy; in basilar meningitis, headache and optic atrophy. Each symptom calls for special treatment or medication; it remains only to be insisted upon that a symptom occurring with syphilitic disease of the nervous system calls for the same treatment that would be accorded it as the result of other causes. For instance, the occurrence of epileptic attacks with symptoms indicating a cortical pachy- or leptomeningitis calls for bromides in addition to insistent antisyphilitic medication or extirpation, as though the epilepsy were dependent upon some other cause. Headache, which is so often a most uncompromising symptom of syphilitic involvement of the dura or pia, is ameliorated by the administration of phenacetin, antipyrin, or the like, and by the application of cold to the head. In some cases the administration of even morphine may be required to grant temporary respite. Sleeplessness is similarly treated as though dependent upon an entirely different condition such as neurasthenia by hydriatics, massage, especially stroking of the throat, and by the administration of hypnotics.

Dereliction of the sphincters, a prominent symptom in syphilitic myelitis, requires the same treatment as when it occurs with other varieties of myelitis. As the same may be said of the symptomatic treatment for other conditions, bed-sores, and spasticity, further discussion would seem unnecessary in this chapter.

The Necessity of Treating and Curing Infectious Diseases.—The reasons for not giving extended consideration to the details of preventive treatment of the diseases of the nervous system due to other infectious agents have been stated before. One other topic in this connection deserves brief mention. The idea that it is well for children while they are still young to go through as many as possible of the less serious infectious diseases such as measles, chicken-pox, whooping-cough, and so on, has not yet been entirely eradicated from the minds of the laity. Nor, we fear, is it taught with sufficient insistence by the physician that these seemingly innocuous diseases cannot be left to run their own course without treatment. It is often true enough that these mild infectious diseases require no treatment; but it is none the less a fact that these diseases should be carefully treated when they occur in children afflicted with the neuropathic diathesis, and that every care should be taken to facilitate the removal from the system of the toxins which they always create. The ways and means of doing this do not require consideration. Little more is demanded than proper attention to the eliminatory avenues and to the state of the general nutrition. It is the duty of parents to prevent their children from contracting infectious diseases, as it is the duty of the commonwealth and those who serve its department of hygiene, to prevent the dissemination of these diseases.

The Prevention of Disease of the Nervous System Due to Constitutional Disorders.—Within the last few years it has been shown that a few of the diseases of the nervous system stand in close pathogenic relationship to some blood diseases; such, for example, as sclerosis of the posterior columns of the spinal cord occurring with pernicious anæmia; ataxic paraplegia dependent upon disseminated myelitis occurring with anæmia and conditions that are productive of anæmia, such as cancer and Bright's disease, and the peculiar trophic condition called hypertrophic osteoarthropathy, with chronic pulmonary tuberculosis. Little can be said concerning the prevention of these conditions save that one should be mindful of the possibility of their occurrence when such constitutional diseases exist, and that every precaution should be taken to prevent them. It is not at all improbable that some of the cases of anæmia that are complicated with decay of different segments of the spinal cord are amenable to treatment if taken in time.

The chronic constitutional diseases that have particular relation to the occurrence of nervous diseases are few in number. They are particularly gout, arthritis, diabetes, obesity, and fibrotic diseases of the viscera, such

as the heart, kidneys, and liver. The influence of gout and rheumatism in the production of nervous diseases has been very differently estimated. In France, the arthritic diathesis is given very great importance. In England, some writers contend that the uric-acid diathesis and the presence of uric acid in the system are the commonest causes of functional nervous disease. In this country, neither of them has been found to play the important rôle indicated by these writers. It is undeniable, however, that there is a close if not a frequent relationship between the presence of uric acid in excessive amount, the rheumatic dyscrasia, and the existence of functional nervous disease. But it must not be forgotten that oftentimes such manifestations of perverted and incomplete metabolism are a part of the functional nervous disease and not its cause. Whether it be one or the other it requires treatment; but if it be a part of the nervous disease, and not its cause, treatment directed against the disease itself will be sufficient to overcome it. Diabetes sometimes produces disease of the peripheral nerves and quite as often involvement of the spinal cord, similar to that occurring with pernicious anæmia. Diabetic multiple neuritis causes a clinical picture not unlike that of tabes, and it is therefore not infrequently spoken of as pseudo-tabes. It may also, by leading up to degeneration of the blood-vessels of the brain, be the most important etiological factor in the occurrence of cerebral apoplexy, or indeed of spinal apoplexy. Knowledge of these facts makes the necessity of applying the most approved treatment for diabetes even more urgent. Just what this treatment may be need not here concern us.

Interdiction of Stimulants and Narcotics.—The rôle played by alcohol, tobacco, tea, and coffee in the causation of nervous diseases has been indicated with sufficient explicitness in the preceding chapter. Little remains to be said in this place regarding the necessity of using them temperately or not at all, if the nervous system is to remain intact. Just in proportion as it is realized that narcotics and stimulants of every kind are always injurious to the immature nervous system and that the necessity for self-control to avoid excess is more urgent for the neuropath, just in proportion will these substances become innocuous. Unfortunately, those of neuropathic constitution, for whom alcoholic drinks and tobacco are most injurious, are the very ones who have difficulty in exercising the necessary restraint of their appetite for narcotics and stimulants. They often consume large quantities of both, not only without apparent injury for some period of time, but frequently to the accomplishment of more work. Chain smokers and tea tipplers are often men and women of highly organized nervous system and of more than common mental endowment. Under normal conditions their supply of nervous energy is quickly exhausted, and the effect of the stimulant or narcotic is seemingly to delay this. Such temporary stimulation is at the expense of neural integrity, not only of themselves, but of their progeny.

Avoidance of Physical and Psychical Trauma.—Following the consideration of preventive measures directed to hereditary conditions, to infections and intoxications there remains for examination the means of preventing the pathogenic activities of physical and psychical trauma. In so far as either physical or mental shock may be accidental, the trauma is of course incapable of being prevented. It is not within the province of prophylaxis to control the operations of chance. Many professions and occupations offer unusual opportunity for either physical or mental trauma, or both. Those who take them up are possibly better aware than others of the imminent dangers to which they have exposed themselves. A warning to those of neuropathic heritage of their increased susceptibility to the pathogenic resultants of accidental shock is the only practical prophylactic measure. Other occupations, however, either because of excessive demand of time or toil or because of the incidental worry, are specially deleterious to the health of those with the neuropathic disposition. While lack of interest in life and work is oftentimes a fecund soil for the development of depressing nervous disease, it is also true that there is no more considerable drain upon the nervous system than that which results from the worry due to the acceptance of responsibilities in the absence of the necessary intellectual and moral qualifications.

The mode of life is an object for prophylactic regard, not only in states of health, but in many diseases which do not themselves fall within the class which are receiving consideration in this volume. All nervous disease is accompanied by impaired metabolism and mental depression; these conditions may be sufficient to lead to functional depravity, like neurasthenia, particularly if they occur conjointly with a mode of life which furthers such pathogenic development. It is often extremely desirable to make decided change in a patient's mode of life, and in the surroundings which may be contributing to the existence or occurrence of a disease. It is not sufficient to suggest that such change be made; the physician must give precise and accurate instructions with the purpose of removing as far as possible all sources of irritation and depression. He must examine with care into the locality for possible dampness, malarial conditions, etc. He should familiarize himself with the patient's habits, with respect to bathing, clothing (of especial importance to women), the amount and quality of food, sleep and rest, mental and physical application, relaxation, capacity for enjoyment, time spent in open air, amusements, social position, and its entailments. Transgression in any of these directions should be counselled against and if the physician is unable to secure conformity to his instructions, it is his duty to withdraw from the case. Otherwise he jeopardizes the chances of his patient's return to complete health and his own reputation.

The Avoidance of Unpropitious Environment.—Many diseases of the

nervous system which are themselves innocuous foster states of depression and hypochondriacal tendencies through the treatment that is accorded the patient at home. It must often transpire that many patients in whom the very first symptoms of neurasthenic depression manifest themselves would be better treated apart from the immediate environment in which they occur and away from the surroundings, social and family, which are apt unnecessarily to prolong their period of existence. Outside of the home, private hospitals, sanatoria, baths, water cures and innumerable institutions devoted to the purposes of special modes of treatment offer themselves. They perhaps have a healthful and tonifying effect upon the patient, in compelling him to recognize that getting well is a serious business which is to be accomplished as soon as possible. But there are many drawbacks and dangers connected with the indiscriminate recommendation of commercial sanatoria for the treatment of the majority of nervous diseases. The effect of such incarceration upon some minds is an impression of invalidism. Moreover the collection of large numbers of persons in one locality where they fraternize and discuss their infirmities intensifies all the suggestive factors which produce such a strong psychical impression. The want of sufficient mental and physical activity necessitated by withdrawal from the normal activities of life is also debilitating and productive of hypochondriacal introspection. Elaborate routine treatment in many of these institutions, without sufficient effort at the strict individualization so necessary in nervous diseases, causes agencies which are good enough in themselves to become harmful through excessive application. Imitation also plays an important rôle with patients of neuropathic disposition, and neurasthenics and hysterics are often led to box the compass of real and imaginary symptoms. Close contact with patients suffering from nervous diseases may also tend to the development of similar symptoms in those who have had no trace of them before. This is true not only of institutional life in general, but of the public resorts, hydriatic institutes, and even of fashionable health resorts. Whatever commendation may be extended in future chapters to hydriatic, electrical, or Zander institutes, it must here be admitted that they are more likely to be productive of injury than of well-being if the different physical measures therein applied are not taken with the special advice of the physician in charge and with strict regard to the individualization of the patient.

Work and Calling.—We cannot pass by the topic of the mode of life as this may be modified to the avoidance of nervous disease without dwelling upon the factor of overwork. It is true that many nervous diseases, especially the so-called functional nervous diseases, are often attributed to overwork. In the majority of such instances, however, it is not the excessive work alone which is responsible for the disease, but the combined action of overwork, dietary errors and transgressions, indulgence

in stimulants and narcotics, insufficient sleep, lack of exercise, and neglect of many of the rules of general hygiene that is responsible for the occurrence of the disease. If the latter causes were not operative, it would be almost if not quite impossible for any amount of work to which the individual is capable of applying himself to produce even such a disease as neurasthenia. Work, mental or physical, if divorced from worry, need not be considered an etiological factor in the causation of nervous diseases. It is impossible for the physician to reconstruct the social and political systems of this country which are so conducive to transgressions of hygienic principles and so provocative of nervous diseases; but he can orient those handicapped by heredity or acquisition by pointing out to them that the maintenance of health for them lies in moderation.

Youths of either sex outlining a career that shall result in fame and fortune ought to remember that there is another side to the "self-made" man, one that the general practitioner and neurologist unfortunately often sees, than that depicted in the heroics of those who seek to stimulate the ambitions of the youthful sluggard, and by the laudatory obituary writer. One of the most pernicious and far-reaching entailments of overwork or engrossing routine is the distaste it develops for indulgence in pleasurable enjoyments and relaxations. And as these are essential to the maintenance of health, particularly after a certain period in the life of man, it is disastrous to be led into such a state. Occasionally we encounter to-day, but unfortunately too rarely, a certain quality of temperament or of habit which is best designated as "reserve force." The individual who possesses this quality makes the impression of one who holds the balance, as it were, of all of the powers which he possesses in such a way that they are most readily and easily at his command. There is a suggestion of security, of evenness, and of force which for comparison may be likened to that of the man who lives well within his income, with a substantial capital in reserve, upon which he may draw at will. The nervous man, on the other hand, the restless, breathless, hurrying, worrying man, who never misses a car, never gives himself up entirely to a moment of purposeless amusement or rest, who never altogether relaxes nerve or muscle and who consciously carries over the account of yesterday's mistake, loss, or worry to add to the fund of to-morrow's care, is like the one who is daily living up to the limit of his income—and a little beyond. This restlessness may be constitutional; but even granted that some cases are, oftener by far it is acquired. In the latter it can be avoided, like all bad habits, and in the former it can to a great extent be prevented or overcome if taken in time. The overtaxed men or women who rush breathlessly through a life of care and responsibility would lighten their burdens and avoid the entailments of nervous exhaustion if they would resort to common-sense relaxation at times when nerves begin to tingle

and to vibrate to each passing impression like the strings of a musical instrument drawn to the highest tension, and the lines of the face express too plainly the suppressed outcry of the tired mind, "Is it worth while?"

The Securement of Sleep.—One of the surest ways of avoiding the development of the neuropathic diathesis and impairment of the integrity of the nervous system is by securing an adequate amount of refreshing sleep. No function of the human body is so tolerant of infringement as sleep, and the average man and woman of affairs and duties encroach upon it without compunction or serious thought of the consequences. A normal adolescent individual who is able to recuperate his vitality through the alimentary tract and by means of exercise, bathing, and conformation to other hygienic principles may go for a long time and without apparent evil consequences while sleep is very considerably retrenched. But eventually the loan must be repaid, and if the funds from other sources have been simultaneously expended the consequences are made known not only by disorder of general nutrition manifest in loss of weight, impairment of physical strength and mental energy, but by perversion of function of some part of the nervous system constituting the phenomena of functional disease.

No general rule can be given by which to estimate the amount of sleep that is requisite for a normal individual. It varies with the person and with age. One adult may require nine hours, another but seven; for children and young adults the amount is greater: persons of mature age can often spare considerable and prolonged sleep without apparent bad effect, while very old persons require a great deal of sleep. The amount varies also with the mental constitution of the individual. Feeble-minded persons require more sleep than those of stronger mental constitution. Neuropathic persons are apt to secure too little sleep, although the opposite extreme is taken by some. With these, sleep acts like a narcotic drug to dull their mental and physical activity.

Healthy children need prolonged sleep taken at regular intervals. Children of neuropathic parents stand in double need of it, and its attainment should be made the object of special effort on the part of parent and physician. One of the evidences of the neuropathic constitution in children is an accession of physical and mental energy in the late afternoon and a desire to sit up late with a corresponding sluggishness in the morning. Normal children sleep early in the evening and awaken early in the morning. However inconvenient such habits may be for its parents, the child's health demands that a strict régime be adhered to.

The Eradication of Bad Habits.—Sufficient has been said concerning the influence of abnormal and excessive sexual indulgence in the chapter on causation of nervous disease to indicate the course that should be pursued when such aberrations have to be dealt with. It is not deemed necessary to consider here the various means that have been adopted to break the patient of such habits. It may be said that as

a rule physical restraint is more serviceable in cases of onanism in children than are moral or medicinal measures. In either boys or girls the patient may be required to wear canvas breeches, fastened at the upper end to a circular steel band provided with a lock. This is worn continuously, and removed by the nurse only at stated intervals in response to nature's calls. In older children and in young adults, it is sometimes necessary to adopt what may appear to be harsher measures in order to secure a temporary cessation of the practice during which time appeal can be made to the morale and the physique. Among such measures may be mentioned blistering the glans penis or clitoris with cantharidal collodion or small cantharidal blisters, and passing a piece of silver wire through a portion of the foreskin at the edge of the glans. If the habit is really ineradicable neurectomy of the dorsal nerves of the penis is a justifiable procedure. Unnatural sexual indulgences, aside from masturbation, need not be considered in any detail. That such practices as coitus reservatus, "withdrawal," and other methods of irregular sexual intercourse practised for religious or economic reasons, are injurious to both participants, every physician fully understands. Not a few cases of neurasthenia in the male and of hysteria in the female are traceable to such indulgences.

Education and Bringing up of the Neuropathic Child.—With the exception of the prophylactic treatment of syphilis, no preventive measure in the treatment of nervous disease is so effective as the proper education of the neuropathic child. This education need not differ specifically from that of other children. Its chief feature should be an intensification of the common sense that should be manifest in the intellectual and emotional training of every child. Normal children show frequently enough the results of parental ignorance and pedagogical inefficiency. Those factors that tend to make the education of the average child less effective in equipping him with a character which will enable him to cope with others successfully through the struggle of life will be more noticeable with children of neuropathic diathesis. The best training for the neuropathic child would therefore be the best training for any child; but nevertheless to produce equal results in normal and neuropathic children the parents of the latter are required to exercise more intelligence and self-restraint than is demanded of the parents of normal children. Unhappily, these educational factors are apt to be wanting in the parents of neuropathic children, the very presence of the neuropathic diathesis in the child being an evidence of its presence in one or both parents. The dictum of Oliver Wendell Holmes, that the education of a child should be begun two hundred years before it was born, may appear exaggerated to those who believe in the possibility of the modern school to develop the faculties of the normal child, but with respect to the neuropathic child it is rather less than more than the truth. The

parents of neuropathic children who try to do their duty by their children are frequently led by their own vagaries of emotion and conduct to make up in enervating sympathy for the child what they lack of emotional balance and self-control. The natural weaknesses of nervous children, especially when combined with the extreme sensitiveness which so often accompanies this diathesis, make a leading appeal for sympathy. This enervating environment nourishes the very shortcomings which give occasion to the expression of the sympathy, and thus a vicious arc is formed.

Next to excessive coddling, nagging is perhaps the most frequent evil inflicted upon nervous children by nervous parents. Expecting more of their children than they are able to accomplish themselves, they show little or no comprehension or leniency toward their moral and emotional perversities; indeed, they seem to afflict the child doubly for their own sins. To such a degree is the reaction disastrous that is awakened in neuropathic children by parents wanting in self-control, and not possessed of those qualities of character that serve as a commendable model for the child, that it can be said without peradventure of a doubt that many children who develop nervous diseases and perhaps lead a life of inefficiency, and even crime, could have been reared to a status of physical and moral normality if they had been removed from their parents and placed under the guidance of others whose knowledge and character fit them for the task of developing satisfactory types of human kind. Specific education is but a small factor in determining what the child shall be like. It is therefore not so important that the parents should be learned in ideals of education and approved pedagogical subjects and methods of instruction, as that they should in their conduct toward the child so act as to develop those instincts and impulses and emotions that will lead into channels of mental and moral health. Parents who are cognizant of neuropathic possessions should strive to maintain their health, so that they may bring forth sound progeny. The same attention should be given to pregnancy and to the early years of childhood that is bestowed on the hysterical and epileptic. The physical and moral education of the child should be conducted so as to result in the harmonious development of the individual's *psyche* and *soma*, and particularly the development of general equilibirum of the organism. From the beginning measures should be taken to increase the physiological resistance of the nervous system and to fortify the energizing capacity, by bringing the systems of the body to the highest possible point of development. A high degree of physical health is incompatible with the neuropathic diathesis. Outdoor life, in the country if possible, with its superabundance of air and sunlight and opportunity for physical exercise, is naturally more conducive to the development of resistant physique than the life of a crowded city, with its enforced limitations in all these directions. Unfortunately, such environment is possible only for the few; but never-

theless much can be done in the way of securing some of the advantages of the country by the utilization of the parks, the aquatic and territorial environment of every large city. Children born of neuropathic parents should be given physical education first, and mental education afterward. It is unfeasible to reform the methods of education which have been found to be of greatest benefit to the greatest number, in order that the few whose inherited shortcomings are an unstable nervous organization may be benefited; but such individuals should not be required to conform to pedagogical formulary at the expense of the development of their bodies. Outdoor exercise should be supplemented by gymnasium practice which will develop physical strength and endurance. Moreover, children of nervous parents should have greater care bestowed upon their personal hygiene and alimentation than those sprung from healthy parents. They should be accustomed early to habits of bathing, especially in cold water, so that they may receive the tonifying and sedative benefit of such application, which contributes so much to the prevention of fatigue and exhaustion. Luxuries of diet, stimulants, and sedatives must be absolutely excluded.

The moral education of such children is quite as important as the physical education; in many instances, indeed, it is more important. Unfortunately, it is almost universally neglected. It is difficult to state in a few paragraphs a formulary that shall encompass the proper bringing-up, from a moral point of view, of the children of nervous parents. It would seem almost unnecessary to attempt to do so, not only because this is beyond the province of the physician, but because parents have their own views on the matter. Nevertheless, the physician may do much by emphasizing how necessary it is to inculcate habits of obedience and self-repression, eradication of egotism and selfishness, restraint of temper and capriciousness, and the development of moral courage and of physical and mental self-confidence. Bad habits should be thwarted by suggestion, by precept, and by example. The necessity of strict discipline to eradicate such habits as nail-biting, gasping for breath, grimacing, rolling the eyes, blinking, and the like, needs no particular mention. Of themselves, such habits are not injurious or objectionable save from an esthetic standpoint. Their inhibition, however, is desirable because it is attended with a strengthening of the will which is much to be desired; the existence of such habit indicates nervousness and volitional lack of control over automatic processes. Inclination toward bad humor, sadness, pessimism, egotism, and superciliousness should be combated early, and the youthful person taught that sentiments of unsociability, if allowed to develop, are more potent to produce personal unhappiness than almost any other factor. He should be taught to accept adverse decisions without black looks or mean resentment; to take banter as well as to give it; to control a hasty temper and to stamp out a sulky one; to bear

failure and disappointment with a smiling face and a determined will. Too great care cannot be directed toward the harmonious development of such individuals' emotional life. Premature knowledge of sex, which unfortunately they often gather from literature, the theatre, and the pulpit, is not infrequently the means of awakening morbid and introspective tendencies.

It must not be inferred from what has been said that the life of the neuropathic child should bring him perpetually in contact with a "don't." Formulæ expressed as "don'ts" are much more easy to frame than those which give direct and specific directions of a positive nature. Such formulæ, however, constitute only the beginning of what should be the active effort of those who are interested in the training of the child. Nothing is more disastrous than a life of continual repression. Indeed, when such repression seems necessary the wise parent will check emotionalism not by rules and precepts, but by suggestion, example, judicious silence, and indifference. Children suffer as much from inability to express what they are able to perceive and feel as from the crude expression of almost reflex reaction to the stimuli of their environment. If they are to be led to stability of purpose and soundness of feeling, they must be taught to give expression to those instincts and emotions which are indicative of the beginnings of the growth of a normal healthy mind, and to conduct themselves in accordance with the standards of their elders. The girl perhaps suffers more than the boy from the repression exercised by those placed above them. The girl who feels the necessity of running off surplus energy is told not to be awkward and ungraceful, but to sit quietly in a chair with hands folded, in a ladylike manner; whereas the boy is ordered out of sight of those whom he annoys, and finds comfort and adequate stimulation with his comrades in the street. This failure to train the girl of neuropathic temperament to the exercise of individual volition is perhaps quite as efficient a factor in determining the greater emotionalism of the female sex as compared with the male as is any other factor of physical or moral organization.

The last word that can be said on the training of a neuropathic child, and indeed the most important one to be emphasized in the prophylaxis of almost all nervous diseases, is the necessity of engrossing work that is not beyond the measure of individual capability. It is not meant by this that a child should be kept in school and rigorously required to conform to the standards that have been set by educational authorities. Engrossing play is work in the sense in which this term is here employed. The child's entire being should be kept in activity, and should be called upon by the environment, by its parents and educators, to give expression to a consistent, unified, well-balanced mental, moral, and physical character.

PART II.

THE GENERAL APPLICATION OF REMEDIAL MEASURES IN THE TREATMENT OF NERVOUS DISEASE.

INTRODUCTION.

Drugs are ordinarily prescribed in the treatment of diseases of the nervous system to obtain a supposed specific effect upon a definite pathological condition. They are in consequence often contrasted with physical measures such as the application of water, electricity, and massage, to which is ascribed only a general effect upon disease. Many drugs, however, to which no precise specific action can be assigned are constantly employed in the treatment of disease of the nervous system. In some instances, drugs are recommended for no other reason than that they have been demonstrated by experience to have a beneficial effect upon the general condition of the patient or to have contributed to the amelioration of symptoms appearing in the course of the disease. The first chapter of Part II. will therefore be devoted to a consideration of the applicability of drugs to diseases of the nervous system in general. Succeeding chapters will deal with hydrotherapy, electrotherapy, massage, exercise and rest, and diet. In a concluding chapter on psychotherapy an estimate of the therapeutic value of suggestion and other mental measures in the treatment of nervous diseases will be attempted.

Though the benefit to be derived from the physical measures just mentioned is at the present day scarcely questioned, still they are by no means so generally employed as their usefulness would seem to demand. This is probably due to the fact that their use is imperfectly taught or entirely ignored in medical books and text-books of therapeutics. Such information must be gathered almost entirely from the personal experience of the physician who would avail himself of these measures. This is a painstaking task, and necessitates much experimentation; too often the requisite knowledge and skill are not acquired. On the other hand, it cannot be denied that a wholly unwarranted place is often given to the significance of physical measures and also of mental measures in the cure of disease. A temperate estimate would indeed hold that physical measures, compared with medicaments, are of greater service in the treatment of chronic disease. But nevertheless, drugs and physical measures must be employed simultaneously, the one to supplement the other. Electrotherapeutists, hydrotherapeutists, hypnotists, and masseurs

habitually exaggerate the rôle which these agents are capable of playing in curing disease. The intemperate claims made by such irrational and unwise advocates are largely responsible for the apathy of some and the antipathy of others.

No one who has had considerable experience in the treatment of nervous diseases fails to recognize that at the basis of them is a depravity of nutrition, local or general, which must be overcome before the disease can be eradicated. There are many substances in the pharmacopœia that are reputed to be of service in the treatment of every one of them. But we are quite at a loss to explain the rationale of their use. Very few, if any, have a specific action. Their beneficial effect is due either to the fact that they supply some element in which the system is lacking or to the aid which they give to metabolism. In this way is to be explained the therapeutic efficiency of iron, phosphorus, arsenic, quinine, and the like. Physical measures act in quite the same way. Their physiological action can be, and in a measure has been, determined with similar accuracy to that of drugs.

It is impracticable to make a judicial estimate, in the chapters devoted to the several physical measures and to psychotherapy, of their respective therapeutic values. The general practitioner needs such advisement quite as much as he requires specific directions to guide him in their selection and application. This task will be postponed to the chapters of Part III., devoted to the treatment of individual diseases in which an attempt will be made to estimate, at least approximately, the amount of dependence that can be placed upon each, and the combinations in which they are most useful and reliable.

CHAPTER I.

DRUGS.

Latterly it has become the fashion again to decry the use of drugs as effective agents in the treatment of nervous diseases, and to deny their serviceability. The modern therapeutist, and particularly if he be a recent recruit, seems oftentimes to be burdened with the idea that he owes a duty to the profession to apprise it that the successful treatment of disease consists in the utilization of non-medicinal measures, and that the results to be obtained from the use of physical measures are incomparably greater than from the use of drugs. Such advocates write and speak oftentimes intemperately of the efficacy of massage, hydriatics, Swedish movements, climatic conditions, and psychotherapy, apparently in entire forgetfulness that the applicability of many of these agencies has been recognized from time immemorial, and that in some instances they were used as beneficially a generation or a century ago as they are to-day. The therapeutic possibilities of physical measures are not being decried. That the writer believes them to play an extremely important part in the treatment of nervous disease is sufficiently evidenced by the succeeding pages. He is merely making a statement of fact and at the same time a confession of faith in drugs as remedies. The attitude of great masters of neurology, such as Charcot, Séguin, and Gowers, on this subject is very instructive. Each of them during the zenith of his fame has recorded his faith in drug therapy, and has urged the profession to persist not only in what is called rational therapy, but in empirical therapy.

Drugs are given in the treatment of nervous diseases for one of the following purposes: 1. Specifically, to counteract or overcome a specific organism or the noxious substances produced thereby. 2. Directly, to influence the morbid state or disease, as the administration of iodide of potassium in syphilitic exudations and arterio-capillary fibrosis, silver in tabes dorsalis, the bromides in epilepsy, and arsenic in chorea. 3. Symptomatically, to meet particular indications: thus (*a*) opium and its alkaloids; the synthetic analgesics, such as phenacetin, antipyrin, acetanilid, exalgin, phenocol, and also aconite and veratrine, to relieve pain; (*b*) the antispasmodics, sumbul, valerian, and musk, and the nitrites and bromides, to relax spasm; (*c*) the hypnotics, chloral hydrate, amylene hydrate, sulfonal, trional, tetronal, hypnal, and paraldehyde, to produce sleep; (*d*) the sedatives, gelsemium, belladonna, duboisine, and conium, to effect motor sedation; (*e*) the stimulants, nux vomica, kola, coca, al-

cohol, camphor, ether, strophantus, sparteine, and caffeine, to cause stimulation in states of depression and exhaustion. 4. To assist in tissue reconstruction: the administration of iron when the hæmoglobin is deficient, of arsenic to promote hæmogenesis, and of substances that facilitate digestion and absorption.

Specific Treatment.—Specific medication plays a very small part in the treatment of nervous diseases, except in the manifestations of syphilis. There are no nervous diseases caused by organisms or factors peculiar to it, save tetanus and hydrophobia. The bacteria that cause so many of the acute organic diseases of the nervous system are the same as those which cause disease in other parts of the body, and so far no immunizing serum or antitoxin has been discovered for them. Tetanus and hydrophobia give opportunity for specific medication; and without entering into a discussion of the treatment of the latter, we may say that the administration of tetanus antitoxin is at the present time the most reliable way of thwarting the disease. The results of its use do not compare favorably with those obtained from the use of antitoxin in the treatment of diphtheria; but as the obstacles in the way of preparing a serum of sufficiently high immunizing power to make unnecessary its administration in large quantities are overcome, as they undoubtedly will be, the antitoxin treatment of tetanus will be deserving of all confidence. One of the greatest drawbacks to its use at present is the large quantity that is necessary to give immunity and to overcome the effects of the bacilli and their toxins upon the parenchyma of the cord and brain. Tizzoni estimated that 70 c.c. of his antitoxin would be a beginning dose for a case of moderate severity, and that this quantity could be repeated at intervals of from six to twelve hours. In severe cases the dose should be even twice this quantity. There are a number of tetanus antitoxins upon the market, but we shall speak here only of that prepared and furnished by the New York City Health Department. This is put up in phials containing 20 c.c. of the serum, which is an initial dose given at the first appearance of tetanic symptoms. If the case is severe, and especially if the treatment has not been begun early, a very much larger quantity should be used. From 500 to 700 c.c. or more may be required in a single case. Even in such large amounts, it produces few or no disagreeable symptoms. The remedy is administered by deep hypodermatic injections into some portion of the anterior surface of the body where there is an abundance of subcutaneous cellular tissue. As the results of administering tetanus antitoxin in this way have not been entirely satisfactory, Roux and Bourrel suggested the intracerebral injection of the antitoxin, and performed it successfully in animals. Chauffard and Quenu were the first to use this method in man. The results of their experience and of numerous other French physicians would seem to justify the procedure. During the summer of 1899 an unusual number of cases of tetanus occurred in New

York City, and in the treatment of some of them intracerebral injections were tried, but the results were not so satisfactory as was anticipated. This method of administering antitoxin must therefore be considered as still under judgment.

During the past few years it has been fully demonstrated that certain diseases which are participated in by the nervous system are caused by deficiency or excess of certain internal secretions, and that they develop in connection with disease or disordered function of certain ductless glands. The most conspicuous of these diseases are myxœdema, acromegaly, and Graves' disease or exophthalmic goitre. It is barely possible that the dystrophies have some pathogenetic relationship to disease or morbid activity of the thymus gland. The fact that the testicles and the ovaries have a trophic influence upon the economy through their internal secretion, which is apart from their sperm and germ-plasm production, is sufficiently shown by the results that follow the purposeful removal or accidental destruction of these organs.

The present-day treatment of myxœdema and cretinism is one of the nineteenth century's most brilliant therapeutic successes. It has been abundantly proven that these conditions can have their progress stayed and almost if not quite complete restoration brought about by the administration of thyroid gland or an extract of it. The thyroid secretion is a complex body, and as yet we do not know upon what its remarkable properties as a preservative of the nutrition of the body depend. It is known that it contains several important proteid constituents and iodine. And at one time or another it has been thought that the thyreoproteid, the nucleoproteid, the iodothyrin, or the iodine is the essential constituent, but it has been amply proven that the results of athyroidism are not prevented by the artificial use of any of these constituents.

Thyroid therapy has not yet shown itself to be of conspicuous service in the treatment of any purely nervous disease. It has been used to some extent in the treatment of exophthalmic goitre, but a judicious estimate of the results does not justify us in assigning to it a place among the most serviceable remedies in this disease. Iodothyrin in from three to five grain doses per day in the beginning, and increased to four times this amount, has been used successfully by Weyler in the treatment of Graves' disease after the customary methods of treating this neurosis had failed. He recommends its administration in tablet form. Thyroid gland or a preparation of it has occasionally been used beneficially in scleroderma, in adiposis dolorosa, and in some cases of mental disease attended with alternating mania and stupor. So far, no satisfactory explanation of its action in these cases has been given. It is serviceable in reducing the body weight in simple obesity; and if there is no organic disease of the viscera there can be no objection to its utilization for this purpose.

Thyroid is administered in the shape of the raw gland, one-half of a sheep's thyroid every third day, and increased in frequency and amount until effects are obtained. The drawback to this mode of administration is that it soon disgusts the patient, even though the glands are slightly cooked on the outside, which can be done without impairing the efficiency of the thyroid substance. An extract of the thyroid is now prepared and put up in tablet form by many of the manufacturing chemists, and if it is kept from becoming damp this is the most convenient and efficacious way of administering it. The beginning dose is from two and one-half to five grains. Powders of thyroid, prepared by mincing of the gland with glycerin and alcohol and then evaporated, may be given in from ten to fifteen grain doses, enclosed in capsules or keratin-coated pills. Iodothyrin, from five to thirty grains a day, has also been used with gratifying results.

Extracts of other glands, such as the thymus, the pituitary gland, and the testicle, have been extensively tried in the treatment of many nervous diseases, but as yet no results have been forthcoming to warrant other statement than that further experimentation and use of them are justifiable. Thymus extract has been tried in the progressive muscular dystrophies, but without result. Some writers have spoken of the beneficial effect of pituitary extract in the treatment of acromegaly, and Rolleston has administered a mixture of thyroid extract and pituitary extract in this disease with pronounced relief to the headache and other subjective symptoms. It did not, however, seem to have any effect upon the course of the disease. In my own hands it has been of no service whatsoever.

The annals of so-called testicular therapy constitute a memorial to the fatuousness of man, and indicate the susceptibility of even professional opinion to suggestion and imitation. Every age has sought the wherewithal to express an elixir which should give to those who drank it the gift of youth, health, and beauty. It remained for an illustrious physician of our own period, Brown-Séquard, to boldly affirm and unswervingly contend that he had extracted from the testicles of young animals a substance which when injected into the tissues would serve to rob old age of its infirmities and deal even death a staggering blow. Out of this affirmation grew a mushroom literature which it were better that it never had existed. Even to-day testicular extract in the shape of spermin of Poehl, which is identical with Boettcher's sperm crystals, the specific constituent of the prostatic secretion, but found in all the organs of the body, and a normal constituent of the blood, is very considerably used, especially in parts of Europe, in the treatment of neurasthenia, hysteria, diabetes, and even tabes. In this country different so-called animal extracts or tissue extracts, such as of the brain, the spinal cord, ovaries, pancreas, and "goat's lymph," have been used. Not a scintilla of acceptable evidence has been

offered to warrant the continuance of their use, and they are mentioned here merely to be warned against. Their use exposes the patient to septic injury, and is an unjustifiable procedure.

The use of mercury as a specific in the treatment of syphilis has been considered in the chapter on the prevention of nervous diseases. All that need be said here is that unfortunately it does not meet the requirements of a true specific. We cannot speak of the specific action of quinine in neuralgia or in disseminated sclerosis, even though neuralgia is oftentimes an expression of malarial poisoning, and though disseminated sclerosis occasionally follows in the wake of malaria. If it could be proven that a disease of the nervous system was caused solely by the malarial plasmodium, as it has been suspected that a variety of periodic paralysis is, then quinine would be a specific in its treatment.

The Remedial Action of Drugs.—The way in which drugs act remedially need not here concern us. It would seem that some consider it an opprobrium that drugs act through the psyche to benefit the soma. That valerian and asafœtida often give relief in some spasmodic disorders of a hysterical nature and other hysterical symptoms is universally conceded. It is impossible to say how they accomplish this unless it be by suggestion, for they have neither chemical composition nor constitution that will permit explanation upon any other grounds. But this is no adequate reason why we should not use such drugs, providing they accomplish the results for which they are given and do not produce injury. It matters not how a drug acts so long as it relieves symptoms and ameliorates or cures diseases, and so long as it may be given without causing injury. This should not be construed to mean that substances or compounds whose constitution and nature are unknown are recommended, or that there is any warrant for the use of substances whose composition is known only to one person or association, who advocate its use and attribute to it virtues which we have no means of knowing that it possesses, solely for personal profit. There is yet to be compounded the medicinal preparation whose formula is withheld from the full knowledge of the profession which has been shown by even its most interested advocates to have remedial effects that are not possessed by simple drugs of the pharmacopoeia.

In administering drugs it is very much more satisfactory to know how they act and how far they can be relied upon to produce certain results than to give them empirically. But there are few substances in the pharmacopoeia that meet these requirements. The administration of the symptom medicines, sedative and stimulant, is based upon experimentation in animals and experience in man. The repute of disease medicines, on the other hand, is based almost entirely upon the inherited and acquired experience of the physician. The latter are oftentimes given with quite as much certainty and assurance of success as the former.

The value of many drugs that are now in universal use was discovered

quite by accident. They are to-day as tenacious of the secret of their salutary action as they were in the beginning. For instance, the discovery of the value of the bromine salts in epilepsy by Laycock a half century ago was the result of deliberate and thorough trial of every drug that had been recommended or suggested in the treatment of this mysterious disease. Although the bromides are not adequate remedies for epilepsy, their value exceeds that of all other anti-epileptic agencies combined. In a similar way Gowers discovered the value of borax in certain cases of epilepsy. It seems highly probable that nature has provided substances which, if it were possible to discover them, would overcome the diseases to which mankind is liable, just as she has provided opium to relieve pain, quinine to cure malaria, and thyroid extract to counteract myxœdema. It is our privilege to press on in the endeavor to force her to yield up these secrets; and though groping in the dark may be wearisome to the weak and even hopeless to the impatient, the success that has attended efforts of the past should keep us from becoming disheartened.

The Abuse and Use of Drugs.—In order to secure the full and legitimate effects of drugs they must be given in adequate doses. The amount of any drug that constitutes an adequate dose depends upon many factors, such as the age and sex of the patient, temperament, environment, idiosyncrasy, and quite as much as anything else upon the nature of the disease. The dose of any drug as given in text-books of materia medica is the approximately estimated amount that will produce certain effects in the average individual in states of health and disease. The modifying influences of the above-mentioned factors have been taken into consideration as far as possible, but of course they can be determined accurately only for the individual. Therefore when we speak of the dose of one of the bromine salts in epilepsy, of arsenic in chorea, or of iodide of potassium in gumma of the central nervous system, we mean the amount that will produce beneficial results. All drugs given in excess produce harmful results. It is the amount that will result in the former and avoid the latter that constitutes an adequate dose.

Most of the symptom medicines and some of the disease medicines used in neurological practice are of such potency that their reckless and indiscriminate use is fraught with great danger to the economy. Many nervous diseases are manifest by symptoms of exaltation or depression which are readily relieved by the administration of symptom medicines. There is always danger that they will be given in this fashion until it is seen that they no longer meet the indications for which they were first administered. By that time they will have impaired the patient's health or he will have become dependent upon them for even a degree of well being. Thus it is a very easy matter to relieve insomnia of almost any kind by giving chloral; to rob trifacial neuralgia of its agonizing pain by the administration of morphine; to ameliorate or stay the

phenomena of epilepsy by the exhibition of large quantities of bromide; and to deprive chorea of its most conspicuous symptom, the dance movements, by a few full doses of exalgin. Moreover, the use of these drugs enters into the legitimate therapy of these diseases. But to give them without proper heed of the possible injuriousness to the economy would result in the formation of the chloral or morphine habit, the phenomena of profound bromide intoxication, impairment of vitality inconsistent with life, and hæmolysis attended with alarming symptoms. Indeed, one of the most important things to remember in recommending such drugs is the great liability they have to impair vitality, to disorder digestion and pervert nutrition, and to lead to the formation of a habit.

The drugs most commonly abused are the sleep producers, opium and its derivatives and the salts of bromine. The latter are perhaps given with less discrimination and recognition of possible untoward consequences than any of the others, although the abuse of hypnotics and narcotics is considerable. It seems necessary to dwell at some length upon the abuse of the salts of bromine, for although it is not so great nor so widespread an evil as the abuse of morphine, the administration of the former is entirely in the hands of the physician, while the latter is not infrequently taken by persons on their own responsibility. Physicians seem oftentimes not to be sufficiently apprised of the therapeutic limitations of the bromides, and of the harm that may come from their injudicious administration. In the chapter on epilepsy reference is made to the acute and chronic toxic states that may result from the excessive and long-continued use of these salts. Here it may be said that the salts of bromine are very useful in very few diseases—epilepsy, migraine—and in the treatment of certain habits and deliria, such as those of morphine and alcohol. Despite the fact that few deny the truth of this statement, the bromides are probably used to combat all sorts of nervous symptoms and conditions more often than any other drug. The apparent explanation of this is that they produce sedation, and therefore the immediate results of their administration are apparently beneficial. The real explanation, however, is that the practitioner who prescribes bromide in an indiscriminate way as a "pick-me-up" and to relieve symptoms is frequently the one who treats disease without first diagnosticating it. If the deleterious effects which the bromides often have when given for a considerable time and without simultaneous use of measures to combat them were more generally recognized, the administration of this drug would be confined to its proper limits. Naturally, the bromides are often useful in the treatment of neurasthenic conditions, headache, eclampsia, and the like, and they should be given as symptom medicines. It is their more or less continued and indiscriminate use, particularly in functional disease attended with loss of the nutritional balance, and in organic disease of the nervous system characterized by marked impairment of vitality, that is

warned against. In the varied manifestations of the neurasthenic state the bromides are often given unwisely, because here the immediate sedation which attends their use is often very gratifying to the patient. If it is necessary to restore neuromuscular tone and to cause mental sedation in exhausted states, there are ways of doing this more in harmony with nature's method than by giving a substance which, at its best, tends to disorder digestion and to impair assimilation. When it is necessary to give the bromides continuously and for a long period, as in the treatment of congenital or essential epilepsy, measures must be employed contemporaneously to counteract their pernicious effects upon the general vitality.

The selection of the particular salt of bromine to be used is not so important as the novice might be led to believe after reading the literature on the subject. If he will bear in mind that the bromide of sodium is less apt to disorder the digestion and that it contains a greater percentage of utilizable bromine than bromide of potassium, he need not concern himself particularly with any of the other bromine salts than these two. Bromide of strontium has been highly recommended, particularly in epilepsy, but after prolonged trial with it I have reached the conclusion that it is much less useful than the two bromides mentioned above. Nor does a combination of the bromides seem to have any virtues that are not possessed by single salts. The bromides of arsenic, zinc, iron, and the like have been widely recommended in the belief that they combine the effects of bromine and the other metallic substances. Little reliance should be placed upon them for any therapeutic purposes, and they are in no way to be considered equivalents of bromide of potassium or sodium in the diseases for which the latter are especially useful.

The dose of the bromides cannot be reckoned in grains with any degree of reliability. It varies greatly with the person and the disease. It is the amount that will accomplish the results (or approximate them) for which it is given, without producing injury. What this amount may be must be determined in each instance. The bromine salts should always be given largely diluted with water, preferably some mildly alkaline water. They are usually best tolerated when given after meals. Oftentimes, however, by depreciating the proteolytic action of the pepsin they cause greater derangement of digestion when given at this time than if given between or before meals. Their deleterious action on the skin is best combated by attention to personal hygiene and by the administration of arsenious acid. The latter increases the proteolytic action of pepsin, and in this way directly combats one of the injurious effects of bromide administration.

In no department of therapeutics is there greater risk of using morphine to the detriment of the patient than in the treatment of nervous diseases. There is no pain comparable in severity and intolerability to that of genuine tic douloureux. Many diseases of the nervous system,

such as tabes, neuritis, and pachymeningitis, are attended by excruciating pain, extending over a prolonged period. The physician is oftentimes morally obligated to relieve such pain by the use of morphine. But he should always have in mind when employing this drug for this purpose that these diseases are of a chronic nature and that the pain is sure to recur. Thus he is borrowing temporary pleasure to lend to more or less permanent pain, for eventually the drug will lose its efficacy to relieve the pain, and the patient will in the mean time have formed a habit which will materially add to the difficulty of effecting a cure. The physician should in every case exhaust the capacities of the less injurious analgesics before he essays to use morphine.

Little need be said concerning the abuse of the modern analgesics, such as phenacetin, exalgin, antipyrin, acetanilid, salipyrin, and the like; for they are not often used detrimentally by the physician. He fully appreciates the deleteriousness of their indiscriminate and excessive use, and is governed in their therapeutic application accordingly. A word must be said, however, concerning the tendency of patients to use these drugs without consulting a physician—a tendency that is fostered by druggists and manufacturing chemists who strive to keep in the eye of the public different pain relievers made up of one or more of these drugs in combination. Many patients with neurasthenia and neuralgia of different kinds materially impair their nutrition and jeopardize their chances of recovery by essaying to relieve their sufferings by the use of such nostrums, the capacity of which to ameliorate pain depends largely on their effects upon the vascular supply of the brain and spinal cord. Some of them, such as exalgin, are profound hæmolytics, and the effects that they produce need to be carefully watched so that measures may be taken to combat them. Methylene blue has obtained some reputation as a pain reliever, particularly in sciatica, but it is not so reliable as phenacetin, although it is much less depressant. It may be given in doses of from three to five grains, preferably in capsule form. Thymacetin, a derivative of thymol, is another of the modern remedies that has given satisfaction in some cases of pure neuralgia and in habitual headache. The dose is from five to ten grains given in water and simple syrup.

Of the other pain relievers and sedatives, aconite is one of the most important. It has well-defined indications for its use in the treatment of a few nervous diseases. Properly administered, it is capable of great service in certain forms of neuralgia, tic douloureux, tachycardia, exophthalmic goitre, and some of the manifold encephalic symptoms attending cases of extensive arterial degeneration. The preparation that can be used most advantageously in all of these save the last is aconitia, as originally recommended and prepared by Duquesnel, which is now to be had from any of the manufacturing chemists. In the administration of this powerful drug three things should be kept in mind: these are

that individuals respond to it very differently; that the preparations of different chemists have very different effects, some being quite inert; and that the dose is the amount of the drug that will produce physiological effects. Haphazard administration of aconitia disregards these factors and is naturally worse than no treatment, for it may be injurious.

Gelsemium is frequently used as a sedative and analgesic in neuralgic affection of the fifth nerve and sometimes in migraine. Its physiological effect is first to paralyze the sensory fibres and then, if its administration is continued, the motor fibres. The fluid extract is the most reliable preparation. More than five drops should never be given as the initial dose until the reaction of the patient and the reliability of the preparation have been determined. Then the drug may be given until it produces marked physiological effect. During its administration the patient should be kept in bed under close observation, as the drug acts depreciatingly on the pneumogastric nerve and diminishes blood pressure.

The list of reliable hypnotics has been materially added to during the present generation. Sulfonal, trional, tetronal, somnal, hypnal, and amylene hydrate are those chiefly deserving of mention. Sulfonal is the most reliable. It is less apt to produce unpleasant after-effects and to derange digestion. Its sleep-producing effects are often delayed, and these may be unpleasantly manifest on the following day. Like trional, it is most useful in states of exhaustion and depression not associated with pain. In many instances their action is expedited by giving them with a large quantity of carbonated water. Tetronal is not so reliable as either of the two first mentioned, although it is very often efficacious, even in cases in which the others do not act. Hypnal, a combination of chloral and antipyrin, has the advantage of being tasteless and odorless. Combining as it does the sleep-producing qualities of chloral and the pain-relieving properties of antipyrin, it is oftentimes the most efficacious hypnotic in sleeplessness dependent upon pain. When insomnia is not associated with pain, somnal is a reliable hypnotic. Amylene hydrate is similar in its action to chloral, and is an efficient sensory sedative. It may be given in from one-half-drachm to two-drachm doses.

Formerly the disastrous effects attending the use of the hypnotics were more evident than they are now. This is due to the fact that the modern sleep-producers are less injurious even when taken continually than are chloral and bromidia. The latter is a combination of bromide, chloral, and cannabis indica which has come into considerable use in different parts of the country. Chloral hydrate is a drug which cannot be taken for any considerable length of time without producing profound disorganization in the components of the blood, and creating an appetite for its continuous use which is spoken of as the chloral habit. This habit is even more difficult to cure than the morphine habit, and the inroads which the administration of the drug makes upon the system are

more profound than those attending the use of morphine. In fullest recognition of this it must nevertheless be admitted that despite the efficacy and wider field of usefulness of the modern hypnotics, chloral still maintains its position as the most reliable hypnotic. It should never be given except under the physician's control and with a keen appreciation of the results that may attend its indiscriminate use.

There are a few drugs of such conspicuous or general use in the treatment of nervous diseases that special mention should be made of them. These are nux vomica, arsenic, phosphorus, iodide of potassium and of sodium, and conium.

Nux vomica with its alkaloids, strychnine and brucine, is among the most reliable drugs of the neurologist's armamentarium. It is one of the best stomachics, one of the most reliable cardiac stimulants, one of the most efficacious tonics to the sympathetic nervous system, and it exercises a special influence upon striated muscular fibre. The fact that it has wide application in the treatment of nervous diseases should not make us forget that it has its limitations and that there are many diseases of the nervous system in which its use is positively contraindicated. Of these, we may mention states of exalted sensibility and spasticity. There is danger in its too early administration in inflammatory conditions of the nervous system, such as neuritis, poliomyelitis, and encephalitis, before the inflammatory state has completely subsided. It has the advantage that it may be given hypodermatically, and in the treatment of some diseases, such as spinal progressive muscular atrophy, atrophy following alcoholic multiple neuritis, and tic douloureux, it seems to have peculiar efficacy when given in this way. The most important contraindication to its use are the cerebral palsies.

Arsenic is a drug of deserved repute in neurological therapeutics. It has gained this reputation largely because of its usefulness in the treatment of Sydenham's chorea and different forms of neuralgia. It is also of service in the treatment of tabes and chronic myelitis of non-syphilitic origin. It has long been known that arsenic possesses the property of promoting the formation of red blood corpuscles, and it has recently been proven to have an almost specific action in some blood diseases such as leucocythæmia. During the last few years it has come to be recognized that there are certain affections of the spinal cord of the pathological nature of myelitis and of the clinical nature either of tabes or ataxic paraplegia which are associated with states of profound anæmia. It is believed by many that the lesions of the nervous system are secondary to and dependent upon disease of the blood, but there is much testimony in favor of the view that the vascular lesions and the cord lesions are due to one and the same toxic substance, although the affection of the cord may be sequential to that of the blood. Whichever be the true explanation, arsenic is the most valuable drug in the treatment of

these diseases, and it owes this reputation to its effects in promoting regeneration of the blood and in delaying its dissociation and decomposition. It is not unlikely that it is in this way that arsenic acts beneficially in chorea and in neuralgia. In both of these diseases the blood is invariably diseased. The preparations of arsenic that are most reliable are Fowler's solution, arsenious acid, and arsenate of sodium. The latter can often be given when the former is not tolerated, owing to nausea, lachrymation, and puffiness of the face, which it is apt to produce. Whatever preparation is selected for use it must be given in adequate doses, for it is now generally believed that small doses have little of the beneficial effects that attend administration of the drug in large doses. Arsenic is one of the causes of multiple neuritis, but there is slight danger of such complication in its therapeutic use.

Phosphorus has attained undeserved prominence in the treatment of many nervous diseases such as neurasthenia, neuralgia, insomnia, locomotor ataxia, and different forms of paralysis. This is in a measure due to the fact that because it is an important constituent of the nerve tissue it was looked upon as a food in nervous diseases. As a matter of fact, its utility is not very great. It is merely a fair restorative in states of exhaustion, whether due to functional or organic diseases. It should be given in the form of pure phosphorus, dissolved in alcohol and glycerin, such as Thompson's solution, of which a drachm represents a twentieth of a grain, or in pill form, from one-one-hundredth to one-fiftieth of a grain. Beginning with a small dose, the patient soon gets so that an adequate amount can be taken without producing nausea and eructations, which are the worst features of its use. Naturally when the nervous affection is in association with some such disease of the blood as leucocythæmia, phosphorus may have a more important therapeutic rôle than is here assigned to it.

Conium is a drug that has been used extensively in the treatment of spasmodic wry neck, different manifestions of the tic neurosis, chronic chorea, and as an adjuvant to the salts of bromine in the treatment of epilepsy and to hyoscyamus in the treatment of acute maniacal conditions. The preparations most frequently used are the fluid extract, given in five-drop doses and gradually increased, and the hydrobromate of coniine, given in beginning doses of one-fiftieth of a grain and gradually increased to a tenth of a grain. The patient's idiosyncrasy to the drug and the reliability of the preparation of the drug must be determined in every instance. Many samples of conium are wholly inert, and it is oftentimes necessary to try the wares of one chemist after another until one is found that will produce physiological effects.

Hyoscyamine and duboisine, the former used in the shape of the hydrobromate and hydrochlorate in one-one-hundredth-grain doses, and the latter in the shape of sulphate in one-seventy-fifth of a grain dose,

are important motor sedatives. Their use is confined largely to combating excitement and motor unrest in acute mania, the toxic deliria, and paralysis agitans.

So many organic diseases of the nervous system are due to syphilis that mercury and iodide of potassium find a comparatively large field of usefulness. The use of these drugs is not confined to syphilitic affections alone. Mercury, given in small doses, is an important agency in contributing to regeneration of the blood in many anæmic conditions, and the iodide of potassium and sodium are the most reliable alteratives in chronic degeneration of the blood-vessels and parenchyma. The mode of administration of these two drugs has been considered in the pages devoted to the treatment of syphilis. Here it needs to be said that not infrequently both of them are relied upon too exclusively to meet the indications for which they are given. It is unfair to expect them to do impossible things, such as to regenerate neural tissue after it has been destroyed by syphilitic exudate or new growth. In almost every instance in which these drugs are indicated, a general tonic plan of treatment is necessary in order to get their full benefit. Neglect of this important feature is responsible for the many uncured though treated cases of syphilis of the nervous system, and for some of the untoward results that occasionally follow antisyphilitic medication. The tendency of the iodine salts to disorder digestion and impair nutrition should be continually kept in mind. If they are given well diluted with alkaline water they can usually be taken without much discomfort unless there be special idiosyncrasies. Ordinarily they are best given after meals, but in many cases they are better tolerated if given immediately before meals. Children and some adults are less distressed by them if they are given in skimmed milk or sweet milk.

It is unnecessary to devote considerable space to the use of tonics and stimulants of the circulatory system, or of general alteratives and restoratives in the treatment of nervous diseases. The principle upon which these drugs are given in such diseases is the same as in the treatment of general diseases.

Many drugs are more or less confidently recommended in the treatment of nervous diseases which have no secure foundation, either physiological or empirical. They are recommended by one writer after another and one generation after another, yet no one is willing to say just how useful or useless they are. Such are silver and aluminum in sclerosis of the spinal cord, zinc in hysteria, copper in the tic neurosis, and gold in the different degenerations of the nervous system. All that can be said is that their use is founded in empiricism, that they are a part of our inherited experience, and that apparently they merit their reputations as remedies.

The following table has been prepared to show the dose and use of the drugs oftenest prescribed by the neurologist. The numbers refer to the diseases or symptoms tabulated below.

Acetanilid (antifebrin), gr. v.–xv. ..... 31, 49, 55, 56, 63.
Aconite, gr. ¼–½ ..... 3, 4, 30, 49, 50.
Aconitine { gr. 1/100–1/500 amorphous ..... } 30, 49, 50.
{ gr. 1/500–1/100 crystalline ..... }
Agathin, gr. viii.–x. ..... 39, 76.
Ammonium bromide, gr. v.–xv. ..... 23, 35.
Ammonium valerianate, gr. ii.–viii. ..... 13, 23, 35, 49.
Amylene hydrate, ʒ i. ..... 39.
Amyl nitrite inhalation ..... 3, 6, 17, 23, 35, 72.
Aniline methyl blue, gr. iii. ..... 31, 49.
Antipyrin, gr. v.–xxv ..... 13, 20, 23, 35, 39, 40, 47, 55, 56, 71.
Apomorphine hydrochlorate, gr. ⅛–¼ ..... 6, 35.
Arsenic, Fowler's sol., ♏ iii.–xv. ..... 13, 65, 71.
Arsenious acid, gr. 1/50–1/10 ..... 13, 32, 50.
Asafœtida, tinc., ʒ ss.–i ..... 6, 17, 34, 35.
Atropine, gr. 1/100–1/50, cautiously ..... 18, 20, 55, 66, 68, 72.
Belladonna, alcoholic extract, gr. ¼–½ ..... 6, 10, 18, 31, 49, 80, 81.
Belladonna, fluid extract, ♏ ss.–i. ..... 14, 17, 23, 25, 48.
Bismuth valerianate, fl. ʒ ss.–i ..... 47, 49, 81.
Borax, gr. v.–xx ..... 23.
Bromamide, gr. x.–xv ..... 39, 51.
Butyl chloral, gr. ii ..... 31, 50, 73.
Caffeine, gr. i.–v ..... 15, 31, 36, 67.
Calcium bromide, gr. ss.–iii. ..... 23, 35.
Calomel, gr. ¼–ii ..... 14, 80.
Camphor, gr. ii.–x ..... 6, 27, 31, 32, 49, 53, 55, 56, 58.
Camphor monobromate, gr. i.–v ..... 13, 19, 31.
Cannabis indica, gr. ¼–½ ..... 6, 13, 17, 19, 35, 38, 49, 72, 73.
Carbon disulphide, gr. ii.–vi. ..... 49, 50, 55.
Charcoal, ʒ i.–iv ..... 28, 81.
Chloralamide, gr. xv.–xlv ..... 39.
Chloral camphor, gr. xviii.–xxx ..... 49.
Chloral hydrate, gr. v.–xxx ..... 2, 6, 13, 17, 18, 19, 23, 39, 44, 72.
Chloral, methyl, gr. x.–xxx ..... 49.
Chloralose, gr. iii.–x.–xx ..... 23, 35, 39.
Chloroform, gr. vi.–xxx ..... 6, 13, 17, 35, 48, 72, 73.
Coca, fluid extract, ʒ i.–ii ..... 35, 51.
Cocaine hydrochlorate, gr. ss.–ii ..... 81.
Codeine, gr. ¼–i ..... 55.
Colchicum, fl. ʒ ss.–ii ..... 6, 49.
Coniine hydrobromate, gr. 1/50–1/10 ..... 17, 19.
Conium, gr. ¼–½ ..... 13, 62.
Conium, fluid extract, ♏ v.–x ..... 19, 75.
Creasote, gtt. i.–iii ..... 80, 81.
Croton oil, ♏ i.–ii ..... 16, 43, 49.
Duboisine sulphate, gr. 1/50–1/10 ..... 39, 44, 60, 76.
Ergot, fl. extract, gtt. v.–xxx.; extract, gr. iii.–x. 48, 58, 79.
Eserine, gr. 1/50–1/30 ..... 25.
Ether, ʒ ss.–i ..... 6, 17, 29, 44, 49, 55, 66, 69.
Ethyl bromide inhalation ..... 23.
Euphorin, gr. v. ..... 31, 49.
Exalgin, gr. ii.–v ..... 13, 31, 49, 55.
Gelsemium, fluid extract, gtt. ii.–xv. ..... 2, 13, 19, 23, 31, 32.

Gold bromide, gtt. viii..... 2, 23.
Gold and sodium chloride, $\frac{1}{30}$–$\frac{1}{10}$–$\frac{1}{15}$–$\frac{1}{15}$..... 19, 49.
Hoffman's anodyne, ♏ xv.–lx..... 6, 15, 17, 18, 36, 40.
Hops, tincture of, gr. v.–lx..... 2, 19, 39, 55, 76.
Hydrobromic acid, ♏ ii.–x..... 23.
Hyoscine hydrobromate, gr. $\frac{1}{120}$–$\frac{1}{60}$ ..... 6, 18, 35, 39, 44.
Hyoscyamine sulphate, gr. $\frac{1}{100}$–$\frac{1}{60}$..... 44, 53.
Hyoscyamus, fluid extract, gtt. v.–x..... 31, 39, 55.
Hypnal, gr. xv ..... 39.
Hypnone, ʒ ss.–i ..... 39.
Iodine, gr. $\frac{1}{4}$–i., externally ..... 41, 49.
Iron bromide, gr. v.–x..... 12, 13, 31, 35.
Iron valerianate, gr. ss.–ii..... 20, 31.
Lavender oil, gtt. i.–v..... 31.
Lithium bromide, gr. v.–x ..... 1, 23.
Lupulin, gr. x.–xv..... 2, 10, 39.
Menthol externally ..... 6, 31, 49, 55, 63, 80.
Mercuric iodide, gr. $\frac{1}{16}$–$\frac{1}{8}$..... 61.
Methylal, gr. x.–xxx..... 39.
Methyl chloride, gr. iii.–xx ..... 62.
Methylene blue, gr. i.–ii ..... 63.
Monobromate, gr. i.–v..... 35, 39.
Morphine, gr. $\frac{1}{8}$–$\frac{1}{4}$ ..... 14, 55, 80.
Musk, tincture, ʒ ss.–ʒ i..... 15, 17, 23, 40.
Nitroglycerin, $\frac{1}{100}$–$\frac{1}{100}$ in pills, $\frac{1}{30}$–$\frac{1}{15}$–$\frac{1}{15}$ ..... 3, 4, 6, 15, 17, 26.
Opium, gr. $\frac{1}{4}$–i ..... 6, 20, 34, 35.
Osmic acid, gr. $\frac{1}{64}$–$\frac{1}{4}$ ..... 23, 63.
Paraldehyde, ʒ ss.–ii ..... 39.
Phenacetin, gr. v.–xv ..... 6, 23, 35, 47, 49, 55, 56, 71.
Phenocoll hydrochloride, gr. x.–xv..... 49, 56, 63.
Phosphoric acid, dilute, gr. $\frac{1}{100}$–$\frac{1}{30}$..... 16, 35, 37, 55.
Phosphorus, gr. $\frac{1}{100}$–$\frac{1}{30}$..... 37, 49.
Pilocarpine, gr. $\frac{1}{32}$–$\frac{1}{8}$ ..... 78.
Potassium arsenite liquor, ♏ v.–xv ..... 13.
Potassium bicarbonate, ʒ ss.–i..... 31, 41, 51.
Potassium bromide, gr. v.–vi..... 3, 17, 19, 23, 35, 37, 53, 72, 80, 81.
Potassium cyanide, gr. $\frac{1}{4}$–$\frac{1}{6}$..... 49.
Potassium iodide, gr. v.–lx..... 20, 23, 41, 46, 58.
Quinine sulphate, gr. i.–x..... 45, 74, 80.
Quinine valerianate, gr. ss.–ii..... 31, 32, 49.
Salol, gr. x.–xv..... 23, 25, 31, 56.
Salipyrin, gr. xv ..... 31, 56.
Salophen, gr. x.–xv ..... 1, 31, 49.
Silver nitrate, gr. $\frac{1}{4}$–ii ..... 12, 23, 61, 71.
Simulo ..... 13, 23, 60.
Sodium arseniate, gr. $\frac{1}{60}$–$\frac{1}{20}$..... 6, 13.
Sodium bromide, gr. xv.–ʒ i..... 13, 19, 23, 51, 72, 81.
Sodium hypophosphite..... 80.
Solanin, gtt. xxx.–lx..... 6, 28, 49, 55, 63, 76.
Somnal, ʒ ss.–i..... 39.
Sulphonal, gr. xv.–xxx..... 39.
Sumbul, gr. x.–xx ..... 6, 23, 34, 35, 39.
Strontium bromide, gr. x.–xxx ..... 23.

Strychnine, gr. $\frac{1}{30}$-$\frac{1}{20}$ ..... 1, 7, 8, 9, 37, 54, 58, 73.
Tetronal, gr. x.-xl..... 39.
Trional, gr. x.-xl..... 39.
Valerian, gr. ss.-ii ..... 31, 32, 34, 35.
Zinc bromide, gr. iii.-x..... 13, 23, 35.
Zinc chloride, gr. ss.-ii ..... 13, 23.
Zinc cyanide, gr. ss.-ii ..... 13, 23, 49.
Zinc iodide, gr. ss.-ii ..... 13, 23, 35.
Zinc oxide, gr. ss.-ii ..... 13, 23, 31.
Zinc phosphate, gr. ii..... 13, 23, 38.
Zinc valerianate, gr. ss.-ii ..... 20, 23, 35, 49.

1. Acroparæsthesia.
2. Alcoholism.
3. Angina Pectoris.
4. Apoplexy.
5. Astasia Abasia.
6. Asthma.
7. Angioneurotic Œdema.
8. Atrophy, Progressive Muscular.
9. Atrophy, Neural.
10. Bladder, Irritable.
11. Bulbar Paralysis.
12. Cardialgia.
13. Chorea.
14. Colic, Lead.
15. Collapse.
16. Coma.
17. Convulsions.
18. Cramp.
19. Delirium Tremens.
20. Diabetes Insipidus.
21. Dystrophy.
22. Encephalitis.
23. Epilepsy.
24. Erythromelalgia.
25. Enuresis.
26. Gangrene, Symmetrical.
27. Graves' disease (see exophthalmic goitre).
28 Gastralgia.
29. Gastrodynia.
30. Goitre, Exophthalmic.
31. Headache.
32. Heart, Palpitation of.
33. Hydrocephalus.
34. Hypochondriasis.
35. Hysteria.
36. Hystero-Epilepsy.
37. Impotence.
38. Insanity.
39. Insomnia.
40. Laryngismus Stridulus.
41. Lead Poisoning.
42. Lethargy.
43. Lumbago.
44. Mania.
45. Meningitis.
46. Mercurial Tremor.
47. Migraine.
48. Myelitis.
49. Neuralgia.
50. Neuralgia, Trigeminal.
51. Neurasthenia.
52. Neuritis.
53. Nymphomania.
54. Optic Nerve, Atrophy of.
55. Pains, Inflammatory.
56. Pains, Tabic.
57. Paralysis.
58. Paralysis, Infantile.
59. Paralysis, Lead.
60. Paralysis Agitans.
61. Paraplegia, Spastic.
62. Satyriasis.
63. Sciatica.
64. Sclerosis, Multiple.
65. Sclerosis, Combined.
66. Shock.
67. Somnolence.
68. Spasm, Local.
69. Syncope.
70. Syringomyelia.
71. Tabes.
72. Tetanus.
73. Tic Douloureux.
74. Tinnitus Aurium.
75. Torticollis.
76. Tremor.
77. Trismus Nascentium.
78. Uræmia.
79. Urine, Incontinence of.
80. Vertigo.
81. Vomiting of Pregnancy.

CHAPTER II.

HYDROTHERAPY.

HYDROTHERAPY, by which is generally meant the external application of water in the treatment of disease, has been practised since the time that disease began. Like other physical agencies, it was highly thought of and much used by the ancients, but it fell into disrepute with the advent and dominancy of Galen and his disciples and their methods of treating disease by the use of drugs. The field being thus left free to all, priests, "born doctors" and those imbued with the spirit of charlatanry took it up to the betterment of their fortunes, and in many instances to the perpetuation of their names. Only during the present generation has it come to be applied according to scientific principles. When the phenomena of disease began to be interpreted rationally, according to the laws of pathogenesis, and when physicians became possessed of comprehensive knowledge of its causation, then came the awakenment to the necessity of preventing disease by maintaining the general vitality, and curing it by restoring the balance of nutrition which had been overthrown. It was soon recognized that physical measures were quite as efficacious to accomplish these, and oftentimes more so than medicines. Among the most important of such physical measures is water. At the present day, the art of applying it in the treatment of disease of the nervous system is a necessary accomplishment of every physician who essays to treat these diseases. The antipyretic and antiphlogistic properties of cold water are much more widely recognized than its stimulating, tonifying, and sedative properties, to which it owes the reputation that it deservedly holds in neurological therapeutics.

An Estimate of the Value of Hydrotherapy.—The adoption of water as a therapeutic agent has been much hampered by the intemperate advocacy of hydriatists, physicians and lay practitioners, who not only lay claim to its usefulness in every disease, but who recommend it as if it were the only curative agency. Many of them, moreover, seem to be dominated by an obsession that the members of the medical profession have covenanted not to use water therapeutically and to deny its virtues as a healing agency. The fervor and zeal which they display in spreading the doctrine of hydrotherapy may be compared to that which animates the conscientious worker in the Lord's vineyard who feels a touch of divinity in having heard a special "call." They are continually gospelizing the application of water in the treatment of all diseases, and at the

same time manifesting a fanatic intolerance of other methods, even physical measures which well-balanced therapists know are of quite as much or even greater value. Attempt to converse with one of these hydriatists on any topic, and he leads back to the subject of water as unerringly as a polarized needle swings round to point to the north. Listen to such a person talk of the treatment of disease, and one hears water apotheosized. It is unnecessary to say that such claims awaken the suspicion that this simple measure with whose qualities every one is so familiar, and which is in daily use from the moment of birth until after death, could not have kept so long the secrets of its marvellous curative properties from the inquiring human mind. Then, oftentimes, trial of water as a curative measure is disappointing. So much depends upon its proper application that the inexperienced are quite as liable to get disagreeable as beneficial effects from its use. If such an experimenter has had the suspicion that hydrotherapy is not all that has been claimed for it, he now becomes convinced of its uselessness. Finally, many hydriatists have tried to erect an elaborate technique which they hold must be conformed to in order that the best effects may be obtained. Not infrequently they are animated by sordid motives in advancing the interests of some hydriatic institution.

Such one-sided advocacy and biassed testimony on the part of hydrotherapeutists has done more to retard the universal use of water for the therapeutic properties which it undoubtedly possesses than the absurd claims of charlatans and quacks. On the other hand, its use has not become so fully known as it deserves because teachers of medicine and therapeutics have been culpably derelict in not giving space to it in their teachings and writings proportionate to that devoted to other therapeutic measures.

The application of water in the treatment of disease is an art which can be acquired only by experience. Moreover, its haphazard and desultory use is just as contraindicated as is the administration of drugs in a similar way. It is fatuous to expect beneficial results from its illogical and irrational use. To utilize it to best advantage demands not only that one be familiar with the properties of water applied under different degrees of temperature and pressure, but that there be definite clinical indications for its use, which in turn presuppose a correct diagnosis. As the beneficial effects of the application of cold water are co-equivalent to the phenomena of reaction and its structural dependency, it is necessary that these be determined in every individual. The only way to do this is by trial, although experience with the same class of diseases and patients soon teaches certain general principles that are applicable in all cases. Here an endeavor will be made to outline the general indications for the use of water, and to enumerate a few methods of applying it which are well within the reach of the ordinary practitioner. It is often

difficult to convince physicians who have had no experience with the practical application of water that it does not require an elaborate apparatus. Indeed, one of the most frequent comments which I hear from physicians of considerable experience, when speaking to them of water in the treatment of nervous diseases, is that they envy the city practitioner who can avail himself of the advantages of hydriatic institutions. This belief is founded in error. Ablutions, compresses, wet packs, rain-baths, tub-baths, local baths, etc., require very little apparatus for their most successful use, even though they be given with greater precision in institutions devoted to the purpose. It is extremely unadvisable to complicate the procedure of using water therapeutically, in other words to construct an elaborate technique, such as is frequently seen in books on hydrotherapy. On the contrary, every effort should be made to simplify it so that it may be entirely within reach of the general practitioner. In France, hydrotherapy in the treatment of nervous disease occupies a firmer position than in any other country, and there hydrotherapy is synonymous with the use of the douche. Unquestionably the French secure just as good results from this single procedure as we do from a larger number.

At the outset, it is well to state that when certain hydriatic procedures are mentioned as being of service in the treatment of this or that nervous disease, their use in connection with medicinal and dietetic treatment, and oftentimes also in connection with other physical methods of treatment, is always meant.

The object in applying water in the treatment of nervous diseases is to cause stimulation or sedation to the entire nervous system or to certain parts of it. The nature and intensity of the effect which water will produce depend upon the temperature at which it is used, the part and extent of the cutaneous surface to which it is applied, the degree of force with which it impinges upon the skin, the duration of its application, and its association with certain mechanical effects, such as rubbing and activity on the part of the patient. More than all these, however, in determining the amount and kind of its effect, is the individuality or the constitutional peculiarities of the patient. Herein hydrotherapy differs radically from drug therapy. When a dose of morphine, aconite, or digitalis is given, the effects that it will produce may be estimated within narrow limits, except in rare instances in which individuals have what is called an idiosyncrasy. When a hydriatic procedure is ordered, nothing save trial or experimentation can be accepted as a reliable guide. Certain it is that the application of water in one way will cause contraction of the blood-vessels, and in another way dilatation. But here it is not so much the immediate effects of which we speak as the more remote and lasting ones. This position I desire to make clear at the outset, for although possessing a keen appreciation of the value of water in the treatment of nervous diseases, I do not believe it to be a universal panacea.

Effects of the Application of Water at Different Temperatures.—Low temperatures play the most important rôle in hydrotherapy, but high and medium temperatures nevertheless are of great service. As the words heat and cold are always used in a relative sense, it is well to say, in the beginning, just what is meant by the words as they are employed here. This is shown by the following table:

Excessive cold	from	0	to	63° C.	=	32°	to	43° F.
Very cold	"	7°	"	10	"	= 44	"	50 "
Cold	"	11	"	15	"	= 51	"	59 "
Cool	"	16	"	20	"	= 60	"	68 "
Lukewarm	"	21	"	25	"	= 69	"	77 "
Tepid	"	26	"	30	"	= 78	"	86 "
Warm	"	31	"	35	"	= 87	"	95 "
Hot	"	36	"	40	"	= 96	"	104 "
Very hot	"	41	"	50 and 70° C.		= 105°	to	120° F.

External application of water increases or decreases the excitability of the nervous system through the mediation of the sensory nerves and their terminations by virtue of its mechanical and thermal properties. It also causes definite changes in the lumen of the blood-vessels, perhaps also in the vessel walls and remotely in the blood. Warm water and cold water produce quite different results upon the muscular system, the former decreasing, the latter increasing muscular force. The remote effects of the application of water may be conditioned through the vascular system, the glands, excretory and secretory, and therefore through metabolism. Thus it may be made an important agency in contributing to tissue change. Cold applications, when of short duration, cause contraction of the cutaneous blood-vessels. This, in turn, is followed by dilatation, which if associated with increased activity of the heart, as it usually is, causes an accession of metabolism, and this constitutes the physiological basis of reaction and of permanent tonification. The intensity of the effect in the blood-vessels depends upon the temperature of the water, upon the force with which it strikes the skin, upon the duration of the application, and upon the mechanical stimulation to which the skin is subjected by friction, or by the patient himself in the shape of voluntary activity. Water of a very low temperature (below 45° F.), if applied to a large surface of the body for more than a few seconds, causes a more or less prolonged contraction of the blood-vessels, which in turn is followed by what may be called paralytic dilatation. At the same time the heart's action is reflexly depressed, causing consequently lowered blood pressure, not only in the parts of the body to which the water has been applied locally, but throughout the entire economy. This is a state of more or less collapse, which is known as incomplete, or lack of reaction. It is a condition strenuously to be avoided. Therefore one of the most essential results to be had from the use of cold water, it

matters not how it be applied, is prompt and sufficient reaction. There are numerous ways of facilitating and insuring this reaction. One of the most important is to see that the temperature and force with which the water is applied are in strict accordance or conformity with the patient's vitality. Weak, anæmic patients; sensitive women; people at the extremes of life's span, and those whose vitality has been greatly depreciated by disease and suffering, should not be subjected to such extremes of temperature and pressure as people having abundant or normal vitality. On the other hand, if the cutaneous blood-vessels all over the body are somewhat dilated by the external application of heat, by means of the warm sheet, the dry pack, or the hot-air box which is now very commonly used in hydriatic establishments in this country, the application of cold water to the cutaneous surface will not cause such profound contraction of the peripheral blood-vessels with consequent dilatation of the central veins as it does without such preparation. Therefore the vascular phenomena forming the basis of reaction, which, as has already been said, consists of peripheral vascular dilatation and associated increased working power of the heart, will more readily occur. Another means of facilitating reaction is to apply friction and rubbing of the parts during or immediately after the application of water. The mechanical effects are strikingly proved by the active ruddiness of the skin and the subjective glow and feeling of exhilaration. The same effect can be produced by putting the patient in warm covering, or, better still, by sending him into the fresh air to take active exercise. The latter is the common method by which reaction is facilitated. Lack of reaction is oftenest manifest in the extremities, particularly in the feet. In patients of lowered vitality this manifestation is often counteracted by having the patient stand on a warm surface or in warm water during the active treatment, and by active flagellation or the application of dry heat after the treatment.

The effect of the application of cold water will therefore depend very largely upon the promptness and completeness of reaction. If the object is to dilate the superficial blood-vessels all over the body and to increase the amount of blood going to the tissues, therefore to stimulate metabolic function, the effect is produced by applying cold water for a very brief period and then using the means just spoken of for facilitating reaction. Or if the object is to cause determination of blood to the periphery in order that the amount of blood circulating in a sluggish way through an internal viscus, such as the central nervous system, may be lessened and at the same time prompted to greater rapidity of movement, there is no surer way of doing this than by causing the blood to empty into the peripheral vessels, and then to give it its proper velocity by stimulating general cardio-vascular tone. In a similar way is to be explained the effect which the application of cold water has upon accelerating or re-

tarding the activity of the glandular secretion. Although perhaps the latter does not stand in entire relationship to the amount of blood in the gland and the rapidity with which it circulates, these factors are nevertheless very important ones, as has been shown experimentally.

The exciting effects which cold water has are due to excitation of the peripheral nerves and of their terminations in the actively contractile part of the muscular substance. Upon this depends the increase of muscular tone to which it gives rise, and likewise upon it depends the narrowing of the lumen of the blood-vessels. But as with every other form of stimulation, the motor nerves lose their excitability after a very brief application, and then the phenomena of relaxation appear. The golden mean in the application of cold water is to excite the peripheral motor nerves to brief contraction, but not to exhaust their contractibility. Then when the reaction occurs in the shape of blood-vessel dilatation, the peripheral motor nerves which are distributed in the vessels and in other parts of the actively contractile muscular substance will still be responsive to the normal physiological stimuli that are continually going to them.

Cold water applied to the cutaneous surface does not have a selective action upon the peripheral motor nerves; it affects as well the sensory nerves. The effect is a stimulating one to the peripheral distribution of the sensory nerves, if the application is not so intense or prolonged as to render them functionally inactive, which it may do, thus causing anæsthesia. It is quite within the bounds of possibility that the stimulating effects which the mere application of cold water exercises upon the sensory nerves might, if carried to an extreme, cause a pathological condition characterized or attended by exhausted states of the peripheral sensory neurons, such as exists in some forms of neurasthenia and in tabes dorsalis. On the other hand, the improvement of nutrition which follows increased circulation and metabolism around and in the peripheral sensory nerves more than outweighs this possible objection.

Warm applications, especially if continued for a prolonged time, cause a dilatation of the peripheral blood-vessels, retard the frequency of the pulse, and diminish blood pressure. They have a tendency to prevent the neuromusculature from being responsive to physiological stimulation, and thus the reaction which follows their use is a very slow one. This accounts for the sedation and the subjective feeling of quietude and exhaustion which they produce. This is to be kept in mind when it is decided to use warm applications, for their capacity to increase asthenic states is very great. Extremely hot applications, on the other hand, first act as a cardiovascular stimulant, and if not continued for too long a time may have very much the same effect, though to a lesser degree, as cold applications.

The hæmogenic effect of cold applications, followed by prompt and

vigorous reaction, has been definitely established by a large number of observations. Their immediate effect is to increase the number of white blood corpuscles, which is manifest by the relative increase of leucocytes contrasted with the number of the red corpuscles. The remote effect is to increase the number of red blood corpuscles and the amount of hæmoglobin. As in many nervous diseases there is not only oligocythæmia, but anæmia, this is an important point to keep in mind.

Cold water, by which we mean water between 40° and 65° F. (water should never be used at a lower temperature than this, except for local applications), may be used as a tonic excitant in all asthenic nervous diseases, except in certain conditions in which it is specially contraindicated; as a reconstructive agency; as a sedative agency in erethistic nervous states; and as antipyretic and antiphlogistic. As an antipyretic it has no very wide application in the treatment of nervous disease, for few of the acute inflammations of the nervous system are attended with high temperature. As an antiphlogistic it may be used either locally or in the shape of cold packs in the early stages of acute inflammations of the coverings of the central nervous system or of the parenchyma. When it is used in the shape of cold ablutions or cold packs the temperature of the water should rarely be lower than from 60° to 55° F. When ice is employed as a local application the effect should be very closely watched, as intense and persistent neuralgia may result.

As a tonifying agency, water has its field of greatest usefulness in the treatment of functional nervous diseases characterized by depreciation of mental and physical vigor and loss of the capacity to create energy. By far the most important effect to be striven for in the use of water as a tonifying agency is prompt and vigorous reaction. This follows the douche and the prolonged cool full bath or half bath more surely than any other means. The temperature of the body should be higher after their application than it was before, and the patient should experience a feeling of warmth and well-being. It is this effect of hydrotherapy that may be utilized as a most important hygienic agency in the prevention of nervous disease. It serves this purpose by establishing and maintaining the harmony and equilibrium of all the functions of the organism. The action of cold water as an excitant has already been spoken of, and the rationale of its use in asthenic, torpid states of the nervous system is easily understood according to this explanation.

Modes of Applying Water in Nervous Diseases.—Water may be applied in the shape of tub baths, ablutions, packs, rain baths, and douches. Of these, there are many subdivisions, the most important of which in the treatment of nervous diseases will be considered very briefly. Tub baths are spoken of as the full bath, the half bath, and the local bath, such as to the feet, pelvis, or hands. They are also classified according to the temperature at which they are given. The cold full bath of brief dura-

tion is given at an average of 55° F. It will depend largely upon the patient's vitality and upon the evident capacity of the organism to react whether or not there shall be any preparatory treatment, and how the patient should enter the bath, the time that he should remain there, and the treatment to which he should be subjected immediately and remotely after coming out of the bath. If there is reason to believe that the reactive capacity is not very great, the temperature of the water should not be below 60°, and the patient's skin should be vigorously frictioned both by himself and by an attendant while in the tub. The shock of contact with the water may also be lessened by previous splashing of the water on the face, neck, and chest before entering and by vigorous voluntary movements while in the water, particularly by swimming movements if the bath is taken in a tank. The time spent in the water should rarely exceed ten seconds, and on first trial it should be very much less than this, consisting merely of immersion and getting out as quickly as possible. Reaction is usually very prompt, but it should be facilitated, except in the vigorous who take this bath for its hygienic and tonifying effects, to counteract fatigue and increase the working capacity. Even these should be impressed with the advisability of vigorous friction with a coarse towel, a flesh-brush, or with the open hand, followed by active physical exercise for a few minutes, either with the chest weights or some other gymnastic exercises, but preferably by exercise in the open air. The cold full bath is too severe for the ordinary sufferer from nervous disease of any kind, and should rarely be taken unless after preliminary treatment by means of cold ablutions, the douche, or the prolonged half bath. The contraindications to its use are diseases of the heart and arteries.

The prolonged half bath is given with a temperature of water varying from 75° to 60°. The patient after wetting the face and chest enters the one-third or one-half full tub and takes a sitting posture. The amount of water should be sufficient to cover the legs and the pelvis. If the patient is averse to entering water as cold as this, the temperature may be lowered after he gets in, either by means of ice or by running cold water into it. The attendant throws and splashes water of the temperature mentioned above upon the patient and promotes reaction either by manual friction or by means of a flesh-brush, while the patient may devote similar attention to the legs. The duration of the bath should be from one to five minutes. Naturally, the reaction begins while the patient is still in the bath, but it may be increased and prolonged by the usual means after emerging from the tub. It cannot be stated in so many words just what the temperature of the water should be for each patient, or the duration of the bath. This can be determined only by experience. He should be removed before the teeth begin to chatter and any evidences of cyanosis with a weak, thready pulse appear.

As a rule it may be said that the lower the temperature and the more sensitive the patient the shorter should be the procedure—a rule that holds good for all hydriatic applications. On leaving the bath the general douche or some of its modifications may be used, or the patient may receive a general ablution with water of from 50° to 55°. If the patient can tolerate this, it will insure a more thorough and prolonged reaction. The cold half bath is much more useful than the cold full bath, because it occasions less shock to the patient and the reaction that follows is pleasanter and more lasting. There is little danger of the appearance of symptoms of depression which not infrequently occur two or three hours after the cold full bath, even in patients who seem to react thoroughly at the time. Moreover, it gives abundant opportunity for the use of the mechanical effects during the bath which contribute not only to the occurrence of reaction but to the persistence of it. The many modifications of it which will suggest themselves to the practitioner to meet the different indications in different patients and diseases make it an important hydriatic procedure. Indeed, next to the douche, it may be said to be the most available hydriatic appliance as a general tonifying agency and to combat asthenic states of the nervous system. It has the great advantage that it may be taken at home without other aid than a member of the family who has been properly instructed.

Local cold baths are administered in the shape of sitz baths and foot baths, occasionally to other parts of the body. The brief cold sitz bath is given at a temperature of from 50° to 60° and from one to five minutes' duration; while the prolonged sitz bath of from 60° to 65° is given from five to twenty minutes' duration. They are used to increase the tone of the pelvic circulation, especially when such evidences of sluggishness and passive hyperæmia as hemorrhoids and congested condition of the pelvic viscera in the female exist, as a part of the general neurasthenic state, or occurring in hysteria and hypochondria. By reflex action they have the capacity to alter the intracranial blood supply, which action is oftentimes manifested by the relief of some of the cerebral symptoms of neurasthenia, particularly the insomnia. The brief sitz bath is indicated when increased peristalsis or an afflux of blood to the pelvic organs is desired.

Cold foot baths are a very important hydriatic procedure. They are given with water at a temperature of from 52° to 45°, and from thirty seconds to two minutes' duration. They should be given when possible with running water, in preference to plunging the feet directly into cold water; but when running water is not available, the feet should be kept in active movement. The after-effect, both immediate and remote, of the cold foot bath is to cause dilatation of the blood-vessels, and this furnishes the clew for its beneficial use. The cold foot bath is the most important measure in the treatment of habitual cold feet, and especially when this is a symptom of one of the functional neuroses,

such as neurasthenia, epilepsy, and hysteria. By causing dilatation of the blood-vessels it allows a determination of blood to these parts, which in turn causes a lessened amount of blood in the opposite pole of the body, viz., the cephalic extremity; and on this account such baths are very serviceable in the treatment of Graves' disease, and in overcoming the insomnia of the neurasthenic states, especially when the insomnia seems to be dependent upon persistent mental activity, the continuous thoughts running seemingly in the same channel. Cold hand baths may be given in exactly the same way.

Although warm baths have comparatively little applicability in the treatment of nervous diseases, still they are sometimes useful as sedative agencies. We may utilize the same kind of warm baths as cold baths; thus we have the prolonged warm full bath and hot bath; the brief warm sitz bath; and the prolonged hot sitz bath; and the warm and hot foot bath. Warm full baths are given of a temperature of 98° to 90° F., and from five to twenty minutes' duration. They are administered for their quieting effects upon the sensory and motor nerves, and whenever there are indications for a prolonged determination of the blood to the surface in order to promote equalization of the circulation or derivation of the blood from central parts. Thus they oftentimes contribute to peaceful, refreshing sleep, and particularly when there are symptoms of central irritability, such as muscular twitching, fidgetiness, and restlessness. If they are followed by some cold-water procedure, such as simple ablutions, the cold half bath, or the general douche, for the tonifying effects, this form of bath, given just before retiring, is oftentimes of great advantage. After the bath the patient should be put in a linen sheet and wrapped or covered closely with a blanket in order that the peripheral dilatation of the blood-vessels may be kept up. The covering should not, however, be sufficient to cause any considerable perspiration, unless there be special indications for this, because of the debilitating effect that it has upon the patient. The prolonged hot bath is rarely given, except in conditions of sthenic delirium, especially when occurring in persons who are not physically debilitated. In such patients the prolonged hot bath has very great capacity to produce muscular sedation and associate mental quietude. The temperature of the bath should be from 100° to 114°, and the duration of from five to twenty-five minutes. The latter period is fraught with danger, particularly if the patient is not carefully watched. When the temperature of the water gets about 102°, patients have very different tolerance to it. Such a temperature often causes symptoms of heart failure, manifested by sensations of precordial weight and constriction, of distention within the head, dyspnœa, feeble pulse, and dizziness. On the other hand, if the patient remains in only a short time this bath acts as a powerful cardiac stimulant. When the baths are being given to patients who are not in a mental state to apprize the attendant

of such symptoms, the precaution should be taken to wash the face and upper part of the neck with cold water, to immerse the hands once or repeatedly in cold water, and to apply cold compresses, an ice bag, or Leiter's coil to the head. The condition of the pulse and heart's action should be carefully watched, and when there are evidences of markedly decreased blood pressure the patient should be removed. In some instances the prolonged warm bath (temperature, 95° to 99° F.; duration, twenty to sixty minutes) is serviceable to relieve the rigidity and diminish the intensity of the tremor in paralysis agitans.

The continuous warm bath, the water being kept at about the body temperature, is often necessary in the treatment of trophic lesions occurring with destructive changes in the spinal cord from injury or disease. The water is brought to the proper temperature before being put in the tub. A sheet is then put across the tub extending about half way down the interior. Sufficient water to keep the sores constantly immersed is then added. A mild deodorizer and disinfectant, such as permanganate of potassium, should be added to the water. When the patient is incontinent the water must be renewed very often. A small bed-table and properly constructed pillows make the patient far more comfortable than any water bed or air bed can do.

Brief warm sitz baths are given at a temperature of from 95° to 85° F., and from ten to twenty-five minutes' duration. They are useful principally in chronic inflammatory conditions of the pelvic viscera, and have very little place in the treatment of nervous diseases. Prolonged hot sitz baths, given with a temperature of from 95° to 112°, are of use principally to increase the quantity of blood in the pelvic viscera and to counteract pain in these parts. Prolonged hot foot baths, given with the same temperatures, are sometimes of service in causing a derivation of blood to the feet, to relieve symptoms of excessive intracranial vascularity.

The simplest and most available hydriatic application is the ablution. It has the great advantage that it can be taken at home without attendance or apparatus. It is not only of value as a tonifying agency in the treatment of many of the neuroses and organic diseases of the nervous system, but it is invaluable as a preparatory means, especially in women, young children, and sensitive adults, for the use of more tonic and severe hydriatic measures. It consists in the application of water of from 60° to 50° from the hollow hand of the patient or an attendant, or by means of a bath-glove or wash-cloth, the entire body being gone over in this way. If the patient is very sensitive, one part of the body may be splashed, dried, and covered before another is uncovered. The procedure should not last longer than one or two minutes, and it should be followed by vigorous frictioning with the hand, with a rough towel, or with a flesh-brush. If reaction is not prompt and vigorous, and especially if the patient is much debilitated, this being the initial hydriatic procedure, it

is advisable for him to have a hot water bag to the feet during the ablution. It is readily seen that this procedure can be made so mild that even the most delicate patient can take it. For instance, with children and with very sensitive women it is often necessary to begin by having the attendant dip her hands in cold water and rub them rapidly and with friction over only a part of the body. Then, day by day, the surface to which they are applied is increased until gradually complete ablution is reached.

Affusions consist in the application of a volume of water poured from a pitcher or pail upon certain parts, possibly the entire body, of the sitting or standing patient. By pouring the water from a height any desirable mechanical effects from the impingement of the stream may be

FIG. 1.—To Illustrate the Application of the General Pack (First Stage).

obtained. It is the hydriatic procedure that may be used when the douche is not available. The temperature of the water should be the same as for the douche, viz., from 50° to 60° on an average, especially after the patient is somewhat inured to the effects of water. The application itself should not consume more than from five to ten seconds, and the reaction, which is very important in these cases, should be facilitated in the ordinary way. Personally, I have found affusions very serviceable to combat the myasthenia of Sydenham's chorea, and in the treatment of certain forms of neurasthenia, especially in that variety formerly known as spinal irritation. These two measures, the ablution and the affusion, can be safely recommended to the general practitioner who will take the trouble to learn their application as important adjuvants in the treatment of many functional and organic nervous diseases for the purpose of combating the symptoms of asthenia.

The packs that are used in the treatment of nervous diseases are the

dry and wet general pack and the local pack. The technique of applying the wet and dry pack is exactly the same, save that in the former instance the linen sheet is saturated with water. It is illustrated by the accompanying illustrations (Figs. 1 and 2). A narrow bed approachable from both sides is covered with a rubber sheet if this is to hand. Then a blanket and a linen sheet are laid upon the bed so that the borders hang equidistant on either side. The patient lies in the middle of the bed and while the arms are held close against the sides, the overhanging sheet is placed smoothly over him; the ends are brought up over the head and the feet respectively, so that these receive a double covering, the face being left exposed. The blanket is then wrapped around the patient in a similar way, the borders of the blanket being carried

FIG. 2.—To Illustrate the Application of the General Pack (Second Stage).

around beneath the patient's back. Cloths wrung out of ice-water or an ice-bag should be applied to the head to relieve surging of the blood in the head which follows primary constriction of the blood-vessels of the skin.

If the dry pack is used and it is desired to get the patient to perspire freely, the sheet may be warm when the patient is put into it; he may be given hot drinks such as hot weak tea or lemonade, or he may be covered with other blankets. The time that he shall be left in the pack depends entirely upon the effects that it is desired to produce. When free perspiration occurs the patient must be taken out and some cold-water procedure used, such as ablutions, rain-bath, or douches, unless these be contraindicated, to combat the profound dilatation of the peripheral blood-vessels. Such measures give tone to the blood-vessels and cause vigorous reaction.

The temperature of the water in which the sheet is plunged for the

wet pack depends entirely upon the purposes for which it is to be used. In the treatment of nervous diseases it is commonly used as a quieting and tonifying agency, although occasionally it is used as an antipyretic in the early stages of infectious diseases which affect the central nervous system. Usually water from 55° to 65° F. is used. It must be borne in mind that, unlike the douche, ablutions, etc., there are no mechanical effects to facilitate reaction in the use of the pack and we must depend entirely upon the temperature of the water. If the sheet is wrung out of lukewarm water then the effect is to make the patient limp and wretched.

The primary effect of the cold pack is a vasoconstriction due to the effect of the cold on the vasoconstrictors, which in turn is followed by vasodilatation due to irritation of the vasodilators. This probably continues during the entire application. The pulse becomes softer, of somewhat greater volume, and the heart frequency falls. The amount of intracranial blood becomes less when vasodilatation comes and oftentimes sleep occurs, even while the patient is in the pack. After the pack, cold-water applications may be utilized if it be desired to counteract the vascular dilatation.

The duration of the cold pack depends upon the purpose for which it is employed. If to reduce temperature, the sheet must be renewed every ten minutes; if to produce vascular dilatation, from one to two hours. The hot pack is given in very much the same way as the cold pack save that a sheet is never used. If it is desired to give a hot pack of from 105° to 108° F. the blanket should be put in water of from 140° to 150° F. and then wrung out by two persons who grasp the ends of the blanket with dry Turkish towels and twist in opposite directions. While in the hot pack the patient may have ice-water compresses to the head to counteract the phenomena of congestion.

The douche offers one of the most valuable methods for the utilization of water as an excitant and tonifying agency. With the douche the mechanical effects are obtained from the pressure which forces the water through the nozzle. This pressure will vary with the effect that it is desired to produce, generally from one to one and one-half atmospheres, fifteen to twenty pounds to the square inch. The danger connected with the use of too great pressure should never be forgotten, inasmuch as it is capable of causing not alone contusion of the soft parts but grave accidents to the viscera. The temperature of the cold douche should never be below 45° F. The average temperature that is used for a person of fair reacting capacity, when it is desired to give a tonic bath, is from 55° to 60°, and the duration from fifteen to thirty seconds. Beginners and inexperienced persons are inclined not only to give the douche with too great pressure but to prolong it unnecessarily. The duration of the douche should always be in proportion to the reacting

capacity of each patient. For example, the quicker the reaction can be obtained the shorter should be the application of the douche.

The patient is prepared for the application of the douche by being incased for a few minutes in a hot-air box (Fig. 3) or hot blanket; or it is applied without preparation. He then stands with the back to the operator, who allows a stream composed of the output from the smaller tubes with which the nozzle is supplied to impinge against the back for two or three seconds and then against the calves and the

FIG. 3.—Hot Box.

feet. If the patient tolerates this then the operator returns to the back and opens the largest (one-inch) tube of the nozzle and with the full pressure that it is decided to use goes over the entire body, save the head and neck, completing the application within thirty or forty seconds. If the patient is particularly sensitive on certain parts of the body the attendant should be instructed to go over such areas lightly, for there is only disadvantage from inflicting useless suffering. The procedure is usually terminated by giving a spray, or fan douche, which is made by placing the tip of the finger firmly over the end of the nozzle with water under the same pressure (of course the water strikes the body then with

much less force), but from five to fifteen degrees higher temperature in order to facilitate reaction. Occasionally it is necessary to have the temperature of the water used in the spray considerably higher than this. The duration of the fan bath should be from five to ten seconds.

There are many modifications of the method of douching, the most important of which may be comprised under the heading of the local douche. Thus we have local douches for their effect upon the liver and spleen, the pelvic viscera; the epigastric douche for the combating of anorexia nervosum; the cephalic and spinal douches, etc. The most important of the local douches in the treatment of nervous diseases are the

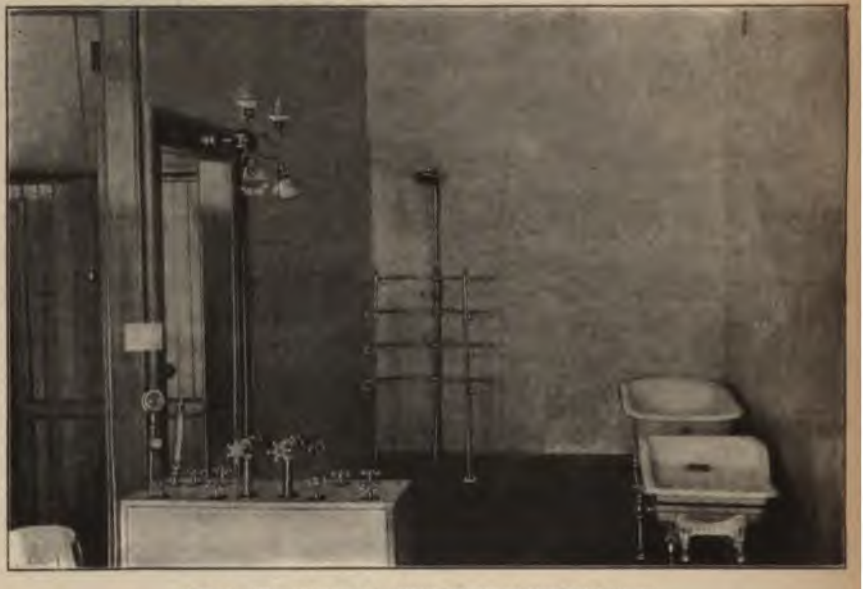

FIG. 4.—The Interior of a Fully Equipped Hydriatic Room.

Charcot and the Fleury douche and the Scottish douche. The Charcot douche is a jet douche that is given through one-sixteenth-inch tubes which the ordinary nozzle is supplied with and under appropriate pressure. It is usually applied to the spine. It is the legitimate successor to the formerly much-used rain bath. It has the all-important advantage that any desired mechanical effect can be got by regulating the pressure. The Fleury douche is a jet douche and shower douche combined, and it has for its object the same purposes as the Charcot douche, but it is more exciting to the peripheral blood-vessels and surer of determining reaction. The Scotch douche consists of an arrangement by means of which alternating streams of hot and cold water are directed against the same part with unvarying pressure. Of course the result of such procedure is that the thermal effects are enormously enhanced. This procedure is therefore

indicated particularly when it is desired to get the sedation which follows intravascular dilatation and hastening of the circulation in previously existing sluggish conditions, such as in neuralgic states. It is also an important agency in stimulating the resorption of inflammatory exudates and in hastening tissue reconstruction. The local douche is always followed by the general douche, as the former is used solely to obtain the local effects. The apparatus is shown in the accompanying illustration and diagram.

Although the douche is the prototype of excitant hydric application, its use is somewhat limited to institutions where the requisite pressure

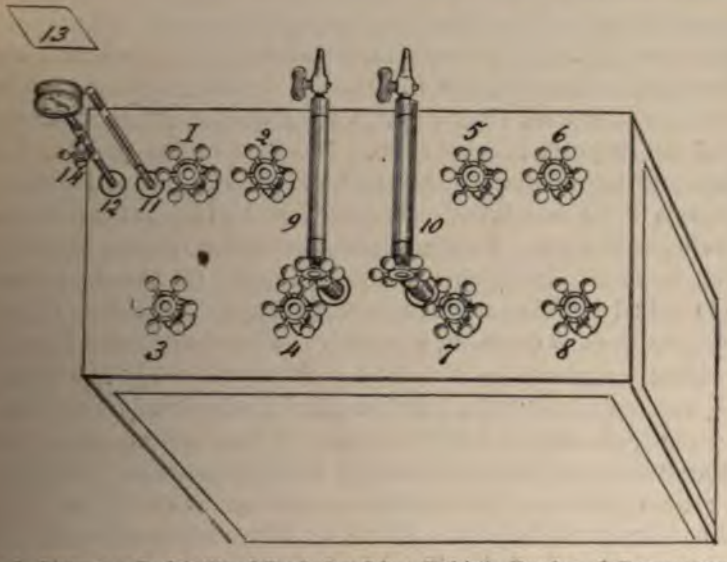

FIG. 5.—Diagram to Explain Use of Nozzle Board in a Hydriatic Chamber. 1, Pressure regulator and waste valve; 2, ice-water supply; 3, hot-water supply; 4, cold-water supply; 5, needle-bath opener; 6, shower-bath opener; 7, hip-bath opener (sitz bath); 8, tub-bath opener; 9, mixed water hose (supply from 2, 3, 4); 10, cold-water hose; 11, thermometer; 12, pressure register (gauge); 13, prescription; 14, clock. Scotch douche is operated by opening 9 and 10, at the same time 4 and 3, the latter only so far as necessary to receive mixture of water at desired temperature.

for its operation can be obtained, either by steam or compressed air, and to high houses in which the pressure is furnished from a tank upon the roof. In the practice of those at a distance from large cities it must be supplanted by ablutions and affusions or some of the other more definitely indicated methods.

There are a number of devices for the local application of water which are made use of to combat certain symptoms occurring with nervous diseases. Of these may be mentioned the psychrophore, which is often serviceable in the treatment of functional impotency; Goldenberg's cooling sounds, used to overcome local manifestations of sexual erethism, and Kemp's rectal irrigator, often of great value in the treatment of mucous enteritis occurring as a symptom of the neurasthenic state. As none of

these has general application they will be referred to in the chapters treating of these subjects.

There are an infinite number of details connected with the therapeutic application of water, all of which cannot be passed in review. It must suffice to refer to the most important of them, which are: the temperature of the room in which the application is made; the question of giving cold baths during the performance of physiological functions such as menstruation and digestion; the advisability of making cold applications to the very young and the very old, and the safeness of such applications in persons suffering from cardiovascular disease, especially arteriosclerosis; personal attention of the physician; and bath attendants. The temperature of the room in which the application of water is made should conform to the hydric procedure, and therefore be determined by the results that one wishes to get from the bath. Cold ablutions, affusions, or douches should not be given in a hot room. Irritation of the peripheral nerves with momentary contraction of the blood-vessels, followed by prolonged relaxation of the vessels with increased vascular tonus, are the results that are being striven for. An atmospheric temperature greater than from 70° to 72° F. would militate greatly against these. On the other hand, care should be had that the patient is not exposed to accidental brief depressions of temperature and draughts, especially in winter weather. It goes without saying that warm baths and hot packs should not be given in a cold room, because the object of their administration would be defeated by the exciting effects which cold air has upon the peripheral blood-vessels.

The Treatment and the Time of Its Application.—There is a firm and seemingly immovable conviction in the minds of the laity, enlightened and ignorant, that baths should be discontinued or interdicted during the menstrual period. Physicians should continually strive to overcome this prejudice, which was conceived and is nurtured in ignorance of the laws of physiology. There is absolutely no reason why bathing for hygienic purposes should be discontinued during this period, and it is my own practice not to interrupt hydriatic applications during this time, save during the second day when the flow is at its height, and then only for æsthetic reasons, unless there be special indications for contrary procedure. It goes without saying that if there exists a tendency to menorrhagia any treatment previously employed that tends to stimulate pelvic circulation or to increase intrapelvic vascular pressure should be stopped during this time. On the other hand, cold water can be made an important agency to stimulate intrapelvic circulation and thus to counteract irregular and insufficient menstruation. The wellnigh universal belief that the contact of cold water to the skin during the menstrual period will cause cessation of menstruation is a relic of bygone days, before the principles of reaction after the application of cold water were interpreted and understood.

No hydriatic treatment should be administered immediately after a meal, even though it be a light breakfast. No more should any considerable procedure be given during the height of stomachic digestion. On the other hand, such measures as affusions and douches should not be given more than two or three hours after some food has been taken, on account of the lowered vitality which abstention from food causes. The most favorable time for the use of water is an hour or so after a light breakfast or in the middle of the afternoon. Cold ablutions and cold rubs may be given before breakfast while the patient is still warm after arising from bed. It is my almost invariable custom, however, to request such patients to take a few ounces of warm milk about a half-hour or an hour before receiving such application. Cold local baths, such as sitz bath and foot bath, and prolonged warm baths are usually given immediately before retiring, on account of the effect which they have to produce sleep.

The age of the patient has very little to do in deciding for or against hydriatic treatment, but it has all to do with determining the form of procedure. Naturally, one does not throw ice-water on weak younglings nor on infirm old men, but there is a golden mean which makes it unnecessary to exempt any age. Bearing in mind that neither the young nor the old tolerate extremes of temperature, and that reaction in such persons is oftentimes much more difficult to obtain than in adults, it will not be difficult for the physician to decide upon the modifications which shall make hydriatic procedure acceptable to the patient according to the age. Patients with arteriosclerosis, particularly if it is associated with any considerable degree of cardiopathy, as is invariably the case if the arterial degeneration has existed for a considerable time, should be subjected to even the mildest cold-water treatment with the greatest caution and circumspection. They tolerate even the mildest forms of cold-water application, such as ablutions, very poorly, and as a general rule it may be said that it is much safer to dispense with them. The condition of the heart, both statically and at the time of the administration of treatment, needs investigation, and especially those cases in which after trial with moderate temperatures reaction does not seem to be satisfying. Nervous, irritable, weak, emaciated persons, with pale skin and cold extremities naturally do not receive the same treatment as full-blooded, robust, warm-skinned individuals, nor is the preliminary and after-treatment the same with such patients. In other words and in brief, the most important factor in the use of water, especially after its thermal and mechanical properties have been fully recognized, is a study of the individual and a recognition of the needs of individualization in its application.

The question of personal supervision and even administration of the hydriatic procedures is one that receives considerable discussion abroad. In some countries, especially in France, it is customary for the physician to give the treatment, but this would seem to be entirely unnecessary, as

the modifications of technique can be made just as well by the trained attendant acting under the orders of the physician. The latter must decide the advisability of such change from the study of the physical conditions following the bath, and from the statements of the patient. In some countries it is the custom for women to bathe men for hygienic purposes, but we see in this only a relic of serfdom and a retardation of social evolution. It will probably never be the custom even in Sweden for physicians to bathe ladies. The most essential qualifications of a bath attendant are amenability to suggestion and capacity for obedience. There are also occasions when an attendant should exercise common sense. But if he is possessed of any beyond this it is as well for him to husband it for other purposes and occasions. As I have said on a number of previous occasions, the technique of administering water is not only a determinable quantity for each patient, but it is one that must be determined.

The question of exercise, drinks, and discipline is one that calls for some discussion. Many quack hydriatists have built up complicated, ludicrous, and absurd systems of exercise in connection with the application of water. It has been said that exercise after the bath is of great service in keeping up a proper degree of reaction. It may now be said that exercise before the application does for the peripheral circulation just what is done by encasement in a hot box, swathing in hot blankets, etc., common procedures preliminary to the bath. When patients are unable to walk in the open air immediately after the treatment, the exercise may be taken on the pulleys and chest weights, or by means of passive exercise and massage. If the patients be kept in the hot-air box for any considerable time preparatory to taking the bath they should be given from six to twelve ounces of water. And as a general rule it may be said that the taking of a course of hydriatics is a favorable time to accustom patients to the discipline of drinking water, which most nervous patients stand sadly in need of. It also offers a favorable opportunity to make more stringent dietetic conformations, especially in regard to the taking of stimulants.

CHAPTER III.

ELECTROTHERAPY.

The therapeutic effect of electricity and the indications for its use in disease can be accorded adequate consideration without inquiry into the nature of the electrical energy employed. It suffices our purpose to know that this form of energy, in whatever way it may be associated with the ether, is generally conceded to contribute to the means of differential diagnostication and to possess remedial properties. Electricity as a force generated and controlled by appropriate apparatus is sufficiently familiar to medical practice to justify definite and assured conclusions as to the results of its action upon the human organisms under different conditions.

The majority of physicians believe electricity to be an agent of approved value in the treatment of nervous diseases. There are, however, many physicians, among them a few leading authorities, who deny that electricity has in reality such virtue. They ascribe the beneficial effects that follow electrical application to the influence of the suggestion of its curative activty. The cases that cannot be explained as thus due to purely psychical therapy they attribute to accident. Many of those holding such nihilistic views with respect to the usefulness of electricity in the treatment of disease substantiate their contention either by the statement of a bare opinion or by the crudest *post hoc ergo propter hoc* reasoning. There are, moreover, some physicians who either because of ignorance of the fundamental principles of electrotherapy or disinclination and incapacity to acquire the details of its application contend that only harm follows its use. These are naturally prejudiced against it and often publish their ill-founded opinion abroad, even though they scarcely possess the qualifications to entitle them to sit in judgment thereon. Finally, not a few physicians exhibit impatience or chagrin at the absurd and extravagant claims of electro-faddists, ill-balanced therapeutists, and charlatans. They refuse to use electricity as a therapeutic agency or soberly to discuss its merits and demerits, claiming that it smacks of charlatanry and expressing a preference for other less mysterious agencies, the results of which are, in their opinion at least, equally satisfactory. In consequence of these unjudicial opinions, the student who would form, without prejudice, a just estimate of the value of electricity in the treatment of nervous disease is bewildered by conflicting testimony and contradictory teaching. In this maze of distorted fact and fanciful reasoning, the Ariadne thread that will safely guide his forming judgment will lead to the golden mean

between the position taken by the electrotherapeutic scoffer and that of him who sees in electrotherapy the rejuvenescence of the senile and the regeneration of the race. The inquiring student must learn to view in proper perspective the opinions of those whose testimony can carry no weight in this or any other discussion. He must remain undistracted by disputations concerning the exact mode of action of the electric force, whether for example it exerts its influence upon the psyche or the soma. He must hold steadfastly before him the real issue, which is: "Does this agent alleviate symptoms and combat diseases?" If the physician will master the simple principles of electricity and give heed to the physiological and physical effects which follow the application of the electric current to the different tissues of the body, he can erect for himself a rational basis for its use. It is unreasonable to suppose that an agent possessing such electrotonic, electrolytic, and cataphoretic properties should be wholly without effect upon normal and diseased tissues. The justification for the use of electricity is based upon empirical results, and the most convincing argument in its favor is found in the fact that it has been serviceably employed and is stanchly advocated as a therapeutic agent by unbiassed, trustworthy, and critical observers.

It seems very doubtful that electricity possesses a *specific* action, at least as it is at present applied. Nevertheless the influence which it exerts in promoting the return of the tissues to a normal state cannot be gainsaid. Although the physical, chemical, and minute physiological changes which it causes in the different tissues, in the structural cells, in blood-vessels and nerves may not be understood, it has been proven experimentally that electricity stimulates living tissue, not only nerve trunks and muscle substance, but the primitive constituent of all tissues, the cell. The result of a mild stimulation reveals itself as augmented metabolism. This in itself is sufficient to warrant its use in many, particularly functional nervous diseases, the causation of which is indicated by nutritional change in different parts of the neuron. The chemical or electrolytic effects are amply manifested in the destruction of tissue if a current strong enough is applied. The diminution or increase in irritability of a nerve, dependent upon anodic and cathodic application respectively, furnishes a rational basis for its use in the treatment of pathological conditions of the nerves which may be attended with pain, and of its employment as an excitor of normal physiological reaction in nerve and muscle wherever muscular contraction is of deficient amount, as the result of peripheral or central disease. The electric current thus performs a service similar to that of massage in promoting involuntary exercise and its resultant beneficial effect upon muscular tissue. In addition, like the application of massage and hydrotherapy, the employment of certain forms of electricity is followed by a distinct and general tonic effect. This may be due in part to the impression that it exerts on the patient's

mind. This psychical reference of the cause of the beneficial effect of electrical application only contributes to the justification of its use.

The Forms of Electricity.—Electricity is used remedially in the following forms: (1) The galvanic, voltaic, chemical, constant, continuous, or non-interrupted current; (2) the faradic, induced, to-and-fro, or interrupted current; and (3) franklinic, frictional, electrostatic, or static electricity.

The force which tends to set electricity in motion or to produce an electric current is called the electromotive force. The generation of this force is one of the conditions upon which depends the existence of electricity as a mode of motion or a phenomenon of energy. It is not itself electricity, but a force capable of producing the electric current under suitable conditions. Electromotive force is generated by chemical action, as in a voltaic cell, or mechanically as in the frictional machine, or by induction as in the induction coil; this force may also be stored in charged storage batteries or in secondary cells. There are other sources of electricity, which, however, do not concern us here; such, for example, as radiant light and heat and the vital energy of organic life.

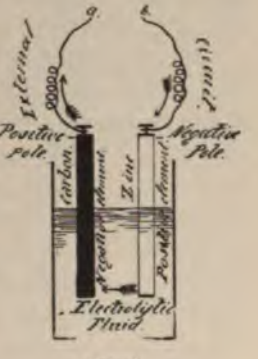

FIG. 6.

Given any source of electromotive force, for example the cell pictured in the accompanying diagram (Fig. 6), electricity will be generated and a flow of the electric current established when a continuous circuit is formed from one to the other element of the cell, constituting the internal circuit, and continued without the cell as a completed external circuit. Thus the cell in the diagram is composed of an exciting or electrolytic fluid and of a bar of zinc and one of carbon placed within the fluid. The electric current will be generated only when the external circuit is made or closed. This can be done by merely tipping the carbon and zinc toward one another until they are in contact; or the external circuit can be made more or less extensive by connecting a conducting wire to the projecting end of the zinc plate, and a similar wire to the end of the carbon, and by bringing into contact the ends of the two wires (*a* and *b* in the diagram). The circuit is then said to be closed and a current of electricity flows from the zinc through the electrolytic fluid to the carbon and thence along the two wires back to the zinc again. Instead of bringing the ends of the wires (*a* and *b*) into contact, they may be placed upon the human body and a circuit be thus completed through the body; or, the wires may be brought into contact with metal or wood and a circuit or flow established through the substances, if the nature of the substance permits. The ends of the wires (*a* and *b*) when brought into contact with the body or

other object, and thus causing a current of electricity to flow through it, are called electrodes. The bare wires are seldom used in this way, but are connected with instruments specially contrived which facilitate the passage of the current from the ends of the wire to the body. The various sorts of electrodes in use for therapeutic work will be considered later. The zinc is spoken of as the positive element, but because the current flows from the external circuit to the zinc, the point of attachment of the wire to the zinc is the negative pole of the battery; the attached wire is the negative wire and its terminal is the negative electrode or cathode. Opposite to these in the diagram and similarly related are the carbon or negative element, the positive pole of the battery, the positive wire, and the positive electrode or anode.

All substances constituting the media through which the electric current passes offer resistance to its passing. Different substances offer different degrees of resistance to the passage or conduction of the electric current. Thus the metals offer very slight resistance and are called good conductors. Silver, copper, iron, and platinum are the best conductors. Those substances that offer enormous resistance are called non-conductors or insulators. Such substances are wood, rubber, vegetable and animal tissues, particularly in the dry state. So much resistance do these substances offer to the electric current that they may be considered as offering absolute barriers to the flow of electricity. The human body offers resistance that is considerably greater than that of the metals. This resistance varies under different conditions. Although water is relatively a poor conductor, and indeed absolutely pure water is considered a non-conductor, the smallest amount of foreign substance renders it a relatively good conductor. Thus the skin, particularly in the dry state, offers very great resistance to the transmission of the electric current, particularly in such parts where the epidermis is thick and devoid of sweat glands, such as the palms and soles. If the skin be moistened with water at the point of contact of the electrodes with the body, the resistance of the epidermis to the current will be materially reduced. A still greater reduction of the resistance will follow the use of a salt solution to moisten the electrodes, the salt in the water being a much better conductor than the water itself. It will be readily understood from this that the relative conductivity of the human body is conditioned by the fluids which it contains. These fluids may be considered as forming a continuous physical mass constituting the path of conduction of the electric fluid. It will therefore not always be determinable what pathway the current of electricity will take through the human body. This path will depend upon the different resistances offered by the different tissues; the path of least resistance will generally be chosen. It is for this reason that the resistance offered by the human body differs so greatly under different conditions and in consequence the laborious determination of the amount of

resistance offered by the body has little practical significance in electrotherapy.

The resistance offered by the conducting wires, the electrodes, and whatever may be placed between the electrodes is called the external resistance. That offered by the electrolytic fluid and the two elements of the battery is called the internal resistance. In order to measure and to quantify the differing resistance offered by the various parts of an electric circuit a standard unit of resistance has been adopted. This unit is called an ohm, after the physicist who framed the law governing the flow of electricity through a circuit. The ohm is the resistance offered by a column of pure mercury 106.3 cm. in length and 1 sq.mm. in cross-section maintained at the temperature of 0° C. In terms of this unit the relative resistance of different substances can be expressed. Thus under ordinary circumstances and with the skin moist, the body offers from 2,000 to 10,000 ohms of resistance, but it may offer as much as 100,000 to 200,000 ohms. The internal resistance offered by the cell or other electrogenic agent may be considered constant and is therefore usually ignored when estimating the resistance offered to the conduction of electrical energy. The amount of resistance offered by a particular substance, by virtue of its own physical structure, is called its specific resistance or resistivity. Resistivity is numerically equal to the resistance offered by a wire of the substance 1 cm. long and of 1 sq.cm. area of cross-section. The resistance offered by such substances as generally constitute the external circuit is not only dependent upon the resistivity of the substance used (thus a wire is a better conductor if made of copper than of iron), but the resistance opposed to the passage of the current depends upon the length and the cross-section of the wire. Other conditions remaining constant, resistance increases directly in proportion to the length of the wire, and diminishes directly with the area of cross-section.

Although the internal resistance is negligible in calculating the amount of current that is at the service of the operator with a given arrangement of batteries and circuit, it is of considerable importance in the choice of the battery to be employed. The force that is generated by a battery or other electrogenic contrivance or substance has a certain capacity to overcome the resistance offered by the external and internal circuit. This electromotive force is measured in terms of a unit, called the volt, after the Italian physicist Volta, who constructed the voltaic cell. The capacity of any electrogenic apparatus to produce a current depends entirely upon the voltage of the electromotive force, that is upon the current pressure developed to overcome resistance to the conduction of a current. Thus the electromotive force of a Leclanché cell is about one and one-half volts, and that of a gravity cell about one volt.

The current that passes over any given point of the external surface

will therefore have a given voltage which is the resultant of the two factors—the electromotive force generated and the resistance offered. The amount of the current that may be supposed to pass any given point may differ. The unit of the measure of the quantity of current is called the coulomb. A more important measure is that of the unit rate of flow, that is, the amount of current that flows by a given point in a second of time. This unit is called the ampere, and its determination is of considerable importance in order to control the intensity of the physiological reaction produced by electrical currents. The arbitrary units of force, resistance, and current rate of flow are defined in terms of one another. Thus an electromotive force of one volt acting upon a circuit of a resistance of one ohm will cause a current in that circuit of one ampere. Ohm's law formulates the relation of these quantities in such wise that the value of any two quantities, being given the third quantity, can be readily determined. The formula is $C=\frac{E}{R}$ in which C equals the current expressed in amperes, E equals the electromotive force expressed in volts, and R the resistance expressed in ohms.

In the practical employment of electrotherapeutical apparatus, the current capacity of the cells used will generally be a known quantity. Thus 30 muriate of ammonia cells may have a voltage of 1.5 and an internal resistance of 0.8 ohm each. The total voltage will therefore be 1.5 multiplied by 30, which equals 45 volts, and the total internal resistance of the cells will be 0.8 multiplied by 30, which equals 24 ohms. Assuming the resistance of the body to be 3,000 ohms, and neglecting the resistance of the conducting wires and electrodes which under ordinary conditions is very small, the total resistance offered by the circuit will be 3,024 ohms. To determine the number of amperes traversing the completed circuit and hence passing through the body, the 45 volts of electromotive force is divided by the 3,024 ohms of resistance, giving a value of 0.0148 ampere, or as this is generally written 14.8 milliamperes.

By the use of the same formula, if the voltage and amperage of a given number of cells are known, the resistance of the tissues that may be interposed in the external circuit can be determined in ohms. These determinations need very seldom be made by the physician himself, because even with the voltage, amperage, and resistance unknown, the amount of current passing through a given circuit can be determined directly by interposing in the circuit properly calibrated instruments that have been devised for this purpose. With the use of such instruments, the electrodes may be applied to any portion of the patient's body and the current turned on, and gradually increased until the desired amount of amperage is registered by the recording instrument. The apparatus ordinarily supplied to the physician is also provided with devices for throwing into the circuit variable amounts of resistance, which render possible the graduation of the strength of currents to the needs of the

occasion without changing the cells or number of cells constituting the source of supply.

The density of the electric current is a variable feature that has an important bearing upon the practical application of electricity to the body. If a current passing along a wire of a given area of cross-section is made to pass along a wire of double this area of cross-section, the density of the current passing along any given longitudinal section of this first wire will be double the density of that passing along a similar longitudinal section of the second wire. This accounts for the different physiological effects of electrodes of large and small area. A current that may produce no distressing physiological effects upon the patient when applied by an electrode which covers a considerable portion of the skin would be intolerable and perhaps unsafe if it was applied through a point electrode. The accompanying figure represents the current as pass-

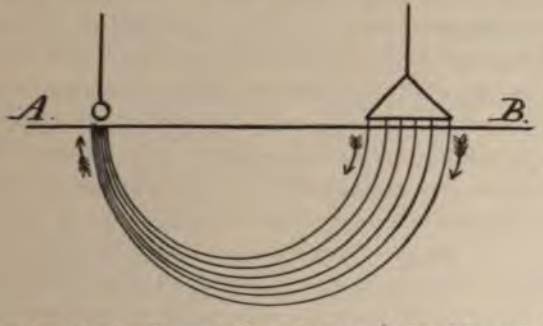

FIG. 7.—Diagram to Show Density of Current when a Large and a Small Electrode are used. *A B* = skin.

ing from a large electrode through and under the epidermis and finally through the epidermis again to a smaller electrode. The electric current in this figure is represented by lines. It will be noticed that before the current passes through the skin to meet the smaller electrode, these lines of electric energy are gathered together or condensed into a single line. Any structure, such as a nerve, lying directly below the smaller electrode would consequently receive a much more effective current than a similar structure lying in the same position beneath the larger electrode. It is quite as important for the physician to control the density of the current by the use of the proper electrodes as it is to control its voltage and amperage.

At least passing mention must be made of the apparatus commonly supplied to physicians for electrotherapeutic purposes. The instruments furnished by different firms vary so widely that a common description applicable to all is impossible. Moreover, the space at our disposal does not warrant a detailed account of the several portions of this apparatus. The firms supplying these instruments provide catalogues amply descrip-

tive and explanatory of the construction and operation of their respective supplies. It remains for us to consider merely the general features of the employment of such instruments; these have a direct bearing upon the therapeutic efficacy of the electric current and therefore cannot be left entirely to commercial literature.

The Galvanic Current.—The galvanic current, which is the one most frequently used in electrotherapy, is furnished by a set of voltaic or galvanic cells, called a battery. Batteries vary in the form, size, and number of cells, ranging from the small portable batteries to elaborate cabinet types. The individual cells differ in voltage from less than one volt each up to two or three volts. They vary also in the number of amperes of current that they will furnish within a given period of time. Some can be quickly exhausted and hence need frequent renewal; others will supply the needs of the physician without attention for a year. The general construction of all these so-called primary cells is the same. A voltaic pair of elements, one of which is electro-positive as related to the other, is immersed in an exciting or electrolytic fluid. The materials chiefly used are zinc, silver, and platinum for the electro-positive element, and carbon, copper, or lead for the electro-negative element. The electrolyte is usually an acidulated fluid or a solution of sal ammoniac. The electromotive force in every form of battery is generated by the chemical action of the exciting fluid upon the electro-positive element. In cells using relatively strong acid solutions, such as the Grenet or acid battery, which is employed because of its high voltage, the elements when the battery is not in use must be removed from the electrolyte in order to prevent the rapid decomposition of the zinc, the electro-positive element. The greater the extremes between the active and passive conditions of the elements immersed in an electrolyte the greater the voltage. The larger the surface of the elements exposed to chemical action the greater is the volume and amperage of the current. Zinc and carbon are most frequently employed as the voltaic pair of elements. The portion of the zinc below the surface of the fluid constitutes the positive element. The electrical energy generated by the decomposition of the zinc is transmitted through the fluid to the part of the carbon below the surface of the fluid, which represents the inactive or negative element. The portion of the carbon projecting above the surface of the fluid and from which the current flows through the external circuit is the positive pole of the battery. The portion of the zinc projecting above the surface of the liquid and to which the current flows from the external circuit is the negative pole.

The bluestone or gravity cell is composed of the two metals, zinc and copper, and the exciting liquid, a dense solution of copper sulphate which occupies the lower part of the cell. A lighter solution of zinc sulphate, which is developed by the action of the zinc and copper sulphate, floats upon the surface of the copper-sulphate solution. This cell is

hence called a double-fluid cell, because of its possessing two exciting fluids. The function of the second fluid, however, is to absorb or combine with the hydrogen that is liberated by the action of the electrolyte upon the decomposing positive element. In the Leclanché cell the negative element is composed of a porous cup containing pulverized carbon and manganese, into which a plate of carbon projects. The manganese performs the function of the second fluid of the gravity battery; that is, it combines with the hydrogen liberated and prevents the polarization of the battery which would render it useless. The positive element is a rod of zinc, while the electrolytic fluid is a saturated solution of chloride of ammonia. These are the two forms of batteries most in use. They are very constant and at the same time inexpensive, and require very little attention. The sal ammoniac or Leclanché battery is somewhat to be preferred because it will remain active for many months without the renewal of any of its parts. The gravity battery needs to be constantly supplied with water as evaporation takes place.

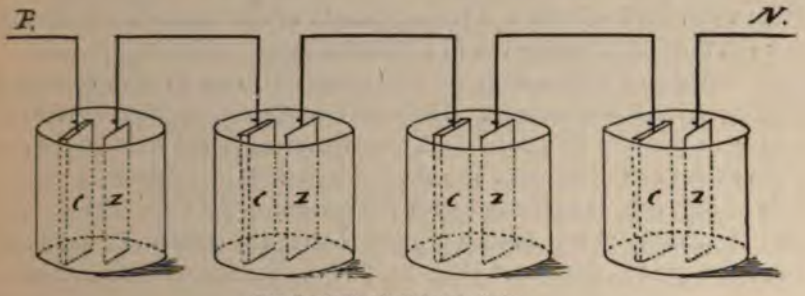

FIG. 8.—A Simple Galvanic Series.

The silver-chloride cell possesses an advantage over the Leclanché and gravity battery in being compact and portable. This cell consists of zinc and silver elements immersed in a dilute aqueous solution of sal ammoniac. The silver element is a wire of silver surrounded by a fused mass of silver chloride. This cell gives a very uniform current of slightly smaller voltage than the gravity and Leclanché cells. The objection to the silver chloride cell is that it does not produce a very powerful current, and must not be short-circuited, that is, placed in a circuit with a very low external resistance. If this takes place, the internal electrolytic action, which converts the silver chloride gradually into metallic silver, becomes very rapid, and the life of the cell may soon be exhausted. These three standard types of voltaic cell are supplied by all dealers in electrotherapeutic supplies. There are many variations in form and size.

A modification of the voltaic cell is the storage cell or secondary cell, to distinguish it from those already described which are called primary

cells. The storage battery can be restored or charged after it has become exhausted. The advantage of this form of cell is found in its high voltage and relatively long life. It is serviceable for furnishing electric cur-

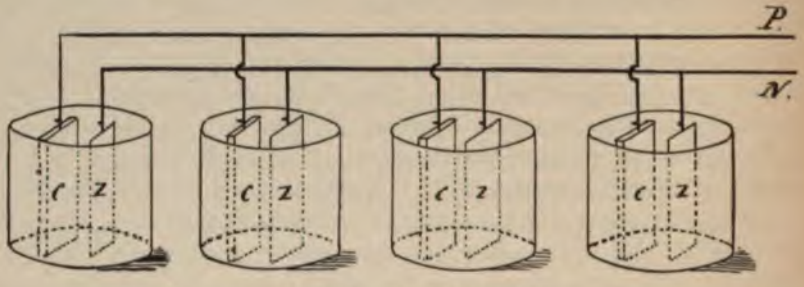

FIG. 9.—To Illustrate Galvanic Series.

rents when high voltage and large amounts of current are desired. It is not put to very extensive use in electrotherapy.

A battery of voltaic cells may be arranged so as to give currents of varying voltage and amount. Different combinations of the cells are necessary to produce this result. Thus, to increase the voltage, the zinc plate at one end of a set of say four cells, which represents the negative pole of that cell, is connected with the carbon of the adjacent cell. The zinc of the second cell is then connected with the carbon of a third cell, and so on for the entire set (Fig. 9). If there are four cells in the battery the conducting wires would be directed to the free carbon pole of the cell at one end of the set and to the free zinc pole of the cell at the other end of the battery. This mode of joining the cells of a battery produces an arrangement of the cells in "galvanic series." The effect of this is to multiply the voltage by the number of cells "in series."

If all of the zincs of a set of four cells are connected together and all of the carbons, and the external circuit is then conducted from these combined carbon poles to the combined zinc poles, the arrangement is called "in multiple arc." The effect of this arrangement is to increase the amperage that can be obtained from the battery without increasing the voltage. The current is the same that would be produced by a single cell of four times the size of the cells of the battery.

Complexer arrangements may be used. Thus, in Fig. 10 the positive pole of the battery is a combination of the carbon poles of two cells, and the negative pole is a combination of the zinc poles of the other two cells. The remaining carbons and zincs are connected. This arrangement doubles the voltage and doubles the amperage. By increasing the number of cells entering into combination, the resultant variations in voltage and amperage that can be obtained from a battery of cells of constant voltage and amperage may be greatly augmented. It is fre-

quently necessary to select a battery according to the kind of work that is desired. Thus living tissue offers very great resistance, and the electric cautery has very low resistance. A current to act upon the first without injury must have large voltage and small amperage; while for the latter small voltage with large amperage is necessary. When electricity is put to a variety of uses, a number of different batteries will be necessary. For most therapeutic purposes, however, a battery of thirty voltaic cells of about one-volt capacity will be ample. As occasion arises, combinations of these cells "in series" and "in multiple arc" will give the variations in voltage and amperage desired. Most galvanic cabinets constructed for electrotherapeutic use contain contrivances that permit of the ready yoking of the voltaic cells in sufficient variety of combination. Indeed, cabinets are often more elaborate than they are convenient. If a portable galvanic battery is desired, care should be exercised in its selection. Particularly the cells should be easily renewed with electrolytic fluid without the necessity of returning them to the maker.

Rheostat and Milliameter.—No electrotherapeutic apparatus is complete without a rheostat and a milliamperemeter or milliameter. The rheostat or current controller is always a part of the external circuit. The current that is flowing through the body is at the same time passing through the rheostat. The amount of current that will flow has been shown to be dependent upon the resistance offered by the external circuit. This device permits the rapid increase and diminution of the resistance of the external circuit. The rheostat is an absolutely essential adjunct, particularly in the poorer types of galvanic batteries in which mechanical devices are not provided for selecting the number and combinations of the cells.

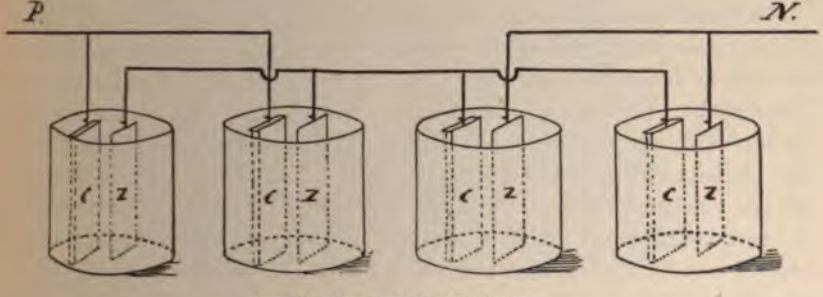

FIG. 10.—Complex Galvanic Series.

It is always a desirable contrivance as it permits of a fine and rapid gradation of the resistance offered by the external circuit, and hence of the amount of current that is acting upon the patient's body. One of the best rheostats is known as the Massey controller, illustrated in Fig. 11. The action of this very simple instrument is based upon the relatively high

resistance of graphite. The movement of the control lever over the sickle-shaped conducting surface varies the amount of resistance offered, because variable areas of the surface rubbed with graphite are placed in successive contact with the lever arm, from which the current must flow

FIG. 11.—The Massey Current Controller.

to and through the graphite surface. Other rheostats equally serviceable, though perhaps not so convenient, interpose variable amounts of resistance in the circuit by the use of alloyed wire, water, or other substances offering great resistance to an electric current.

Another essential attachment to the galvanic battery is a milliameter. With the commonly used direct-reading milliameter, the strength of the current is measured regardless of the size or constitution of the batteries. This enables the physician to duplicate exactly the dosage of the galvanic current without giving details with respect to the kind of cell, the size of the elements, capacity and strength of the fluid, external resistance, and so on. Several forms of milliameter are constructed. The suspension type of instrument consists essentially of a magnet moving freely above a coil of wire through which the current is permitted to flow. Varying intensities of current will cause varying degrees of angular deflection. The amount of deflection caused by currents of different intensities has been determined empirically, and the instrument calibrated to record accurately in milliamperes. The only care that needs to be exercised is that required to adjust the magnet pointer, so that when this points, as will any magnet, toward the earth's north pole, it will coincide with the zero of the scale. The instrument must, of course, be kept in the horizontal position. A difference between the magnetism of the earth's field where the

instrument is calibrated and where used may cause slight inaccuracies to creep in. Another source of false readings may arise from a neighboring magnetic field that may cause deflection of the needle. Milliameters are supplied which are not susceptible to these sources of error. The coil of these instruments is rotated between the poles of fixed permanent magnets. Such instruments are constructed for use in either the vertical or horizontal position. Fig. 12 represents an instrument of this type.

The conducting cords should be of low resistance, thereby insuring the greatest quantity of current conduction. The best are made of a number of strands of flexible copper wires. This cord can be used with the galvanic as well as with the faradic current. The cord that generally forms part of the equipment of a faradic apparatus is made of a material that offers too high resistance for galvanic work.

It is sometimes desirable to change the direction of the current in the external circuit. This could, of course, be effected by interchanging the

FIG. 12.—Milliamperemeter.

wires at their attachment to the positive and negative poles of the battery. Most electrotherapeutic contrivances comprise a commutator or pole changer which will reverse the direction of the current as it passes through the body by the simple movement of a plug, lever, or switch.

Varieties of Electrodes.—Many forms of electrodes are in use. Specially constructed electrodes have been devised for the application of a

current to the head, neck, throat, back, hands, and other parts of the body (Fig. 13). All these electrodes differ in size, and upon the size will depend, as already stated, the current density. Erb's normal electrodes furnish a series of electrodes of known area and permit of the calculation of the density of the current used. As ordinarily applied, one of the two electrodes is regarded as indifferent, and the other as active. The indifferent electrode is generally the large one and is held either in the hand, over the epigastrium, or placed beneath the buttocks in the sitting position. The active or so-called differential electrode is generally small in area. The electrode may be held firmly in position, moved slowly or quickly over an area, or alternately applied to and removed from the part to be influenced. The mode of application may therefore be stabile, labile, or interrupted. The interrupted stimulation, generally employed to produce muscular contraction, is most conveniently applied by an electrode with an interrupting device in the handle. The base of the electrode can then be left permanently in contact with the skin. The electrodes or the skin should be moistened, in order to reduce the resistance. The use of a saline solution is not advisable, because of its corrosive action upon the electrodes. Dirt or other foreign substance upon the electrodes diminishes the resistance and will cause variability in the strength of current received by the patient. Care must therefore be taken to keep the electrodes clean.

The Static Current.—The franklinic or static current is employed when electricity of high potential is desired. As has been already seen, the galvanic current has an electromotive force of but few volts. The static machines are devised to give currents of many thousand volts. These machines were originally devices for the development of electricity by means of friction. Later the influence and induction static machines came into use. Static electricity is first developed upon the plates of the machine by means of friction. The revolution of plates increases the original charge by electrostatic induction, and this electricity is collected or condensed by the use of Leyden jar collectors. The electrodes used to apply the static electricity are of peculiar type. The indifferent electrode is an insulated platform upon which the subject sits or stands. This platform is connected with the negative pole by means of a brass chain attached to a projecting brass rod. The differential electrodes are various in formation. They comprise brass balls and points, rollers of metal, an umbrella-shaped electrode to fit over the head, etc.

Static electricity may be applied in different ways. By the method of insulation one pole of the machine is connected with the earth, or grounded by attachment to some metal fixture in the room, and the other is attached to the patient who is seated or stands upon the insulated platform. The effect of this is not to send a current through the patient, but to charge him as one might a Leyden jar, with either positive or neg-

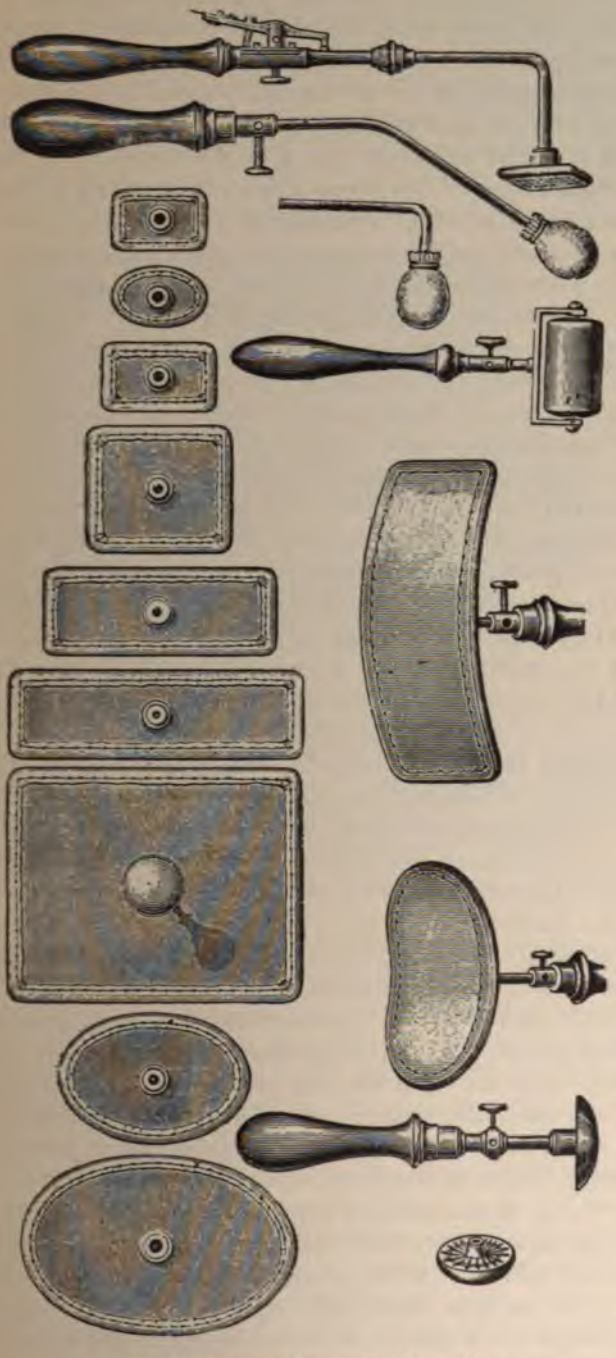

FIG. 13.—Electrodes (Copied from Lacquer).

ative electricity, depending upon the pole of the machine to which he may be attached by the brass chain. The direct-spark method is more frequently employed. The patient is placed upon the insulated platform which is connected with one of the conductors. The differential electrode is held in the hand of the physician and is connected by a brass chain with the other electrode. By applying the electrode to the body of the patient a more or less severe shock can be given, depending upon the distance by which the rods joining the two conductors are separated. The indirect-spark method is less often used. The electrode directed toward the patient's body is attached to a nail in the wall, or otherwise grounded, instead of being applied to the conductor of the machine. The static breeze is produced by using a pointed electrode instead of the bulb or ball. It causes a fan-shaped or breeze-like current to pass between the patient and the electrode instead of the sharply defined spark of the other methods just described. The so-called aigrette is the current produced by a rather blunt piece of wood or metal brought near enough to the patient to give a form of discharge intermediate between the spark and the breeze. By placing the two brass balls which form part of the negative and positive conductors of the instrument at varying distances a rapidly interrupted and graduated current is produced. The specific resistance of the air to the passage of the current between the brass balls acts as a spring interrupter. A spark will pass between these balls whenever the tension of the current exceeds an amount which is proportional to the distance which separates the two balls.

The Faradic or Induced Current.—The faradic, induced, or magneto-electric current finds more frequent use in electrotherapy than does the franklinic current just described. The faradic apparatus consists of several cells developing an electro-motive force sufficient to send a current of electricity through a coil of wire which constitutes the exciting magnetic field. In the primary circuit is placed an automatic interrupter which is generally some form of vibrating device capable of making and breaking a contact, that is, of closing and opening a primary circuit, several hundred times a second. A second coil of wire wrapped on a larger spool, which can generally be slid around the smaller coil of the primary circuit, is in connection with the electrodes that are applied to the patient when faradic electricity is employed. Through the related properties of magnetic and electric currents, whenever the current of electricity begins or whenever it ceases to flow in the primary circuit, a current generally of higher voltage is momentarily developed in the secondary or induction coil. The strength of the current in the secondary coil is dependent upon the number of turns in the two coils and upon the voltage of the primary current, as well as upon the rapidity with which the interruption of the primary current takes place. More significant is the alteration in the strength of the induced current that can be effected by sliding the second-

ary coil over the primary coil. The greatest intensity of current is produced when all of the coils of the secondary coil are directly about those of the primary coil. As the secondary coil is pulled away from the primary coil, the current gradually diminishes in intensity. A similar gradation may be effected while the two coils remain in position one over the other, by sliding a cylinder of metal between the two coils. As the cylinder intercepts increasing amounts of the two coils the current will diminish in intensity. Very ingenious instruments of convenient and port-

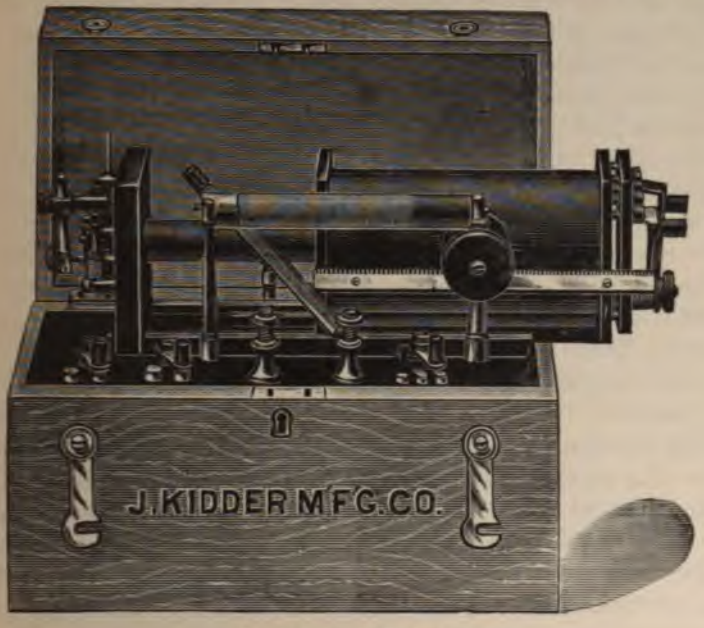

FIG. 14.—Faradic Battery.

able form have been devised for the administration of the faradic current. One of the most serviceable forms is that shown in Fig. 14. The induction coil is made up of sections of wire of different lengths and coarseness so arranged that the sections may be used separately or jointly as a single coil of upward of three thousand feet in length. The apparatus contains a rack and gear for the making of fine adjustments of the coil, a rheostat for modifying the strength of the current, a compound switch for the selection of any section of wire, and the necessary switches for controlling the circuit.

The faradic current cannot be measured as can the galvanic, although attempts have been made to measure it approximately. The method employed has been to keep the initial current passing through the primary coil at a constant quantity by employing variable resistance in the circuit. The voltage of the induced current can be computed from the

voltage of the primary current if the number of turns of wire in the primary coil and the number of turns in the induced coil are known. Other methods have been devised for the empirical determination of the strength of the faradic current as it may be practically applied to the tissues. But these devices are for the most part too complicated for the service of the electrotherapist, and these exact determinations are moreover not requisite for the safe and efficient application of this form of electricity.

A convenient source of electrical energy at the disposal of the physician would seem to be the street current as ordinarily furnished for electric lighting. A tap has been devised which may be connected to an ordinary lamp and attached to a current controller and milliameter. The rheostat will reduce the incandescent current to a range of from zero to five hundred milliamperes. This current may also be connected with the primary coil of a faradic battery. The safety of tapping the street current for medical purposes is still a debatable question, although it is utilized and highly recommended by many leading electrotherapists.

Electrotonus, Electrolysis, and Electrosmosis.—Before the electric current can be applied judiciously in the cure of disease it is demanded of the electrotherapist that he fully appreciate the oftentimes portentous electrical and chemical phenomena to which it may give rise in the tissues. The most important of these are known as electrotonus, electrolysis, and electrosmosis. The animal body is itself a source of electricity and the pathway of natural electric currents. The application of a current to a portion of a nerve at once causes a state of altered excitability—the condition of electrotonus. There is an increased mechanical, thermal, and electrical excitability at the cathode pole, to which the name catelectrotonus is given, and a diminished excitability at the negative pole, known as analectrotonus. This state of electrotonus exists not alone in the segment of the nerve included between the two electrodes, but in the nerve beyond the electrodes, and the stronger the current the greater the area of its influence. This altered condition of excitability in the nerve is most marked near the poles; between the two poles there is a point at which it does not exist, known as the indifferent point. This point is not equidistant from the two poles, nor is it at the same place in the passage of currents of different intensity. With a weak current it lies nearer the anode, while with a strong current it lies nearer the cathode. In other words, a weak current increases the section over which the negative pole prevails, while a strong current increases that over which the positive pole prevails. A nerve is stimulated at the moment that electrotonus occurs and when it disappears, that is, at the opening and closing of the current. At the opening of the current stimulation occurs at the anode, while at the closing of the current it occurs at the cathode, and the cathodal response is normally greater than the anodal. The reversal of this relation of stimulation to the occurrence of catelectrotonus and analec-

trotonus, which takes place in nerves that have been subjected to degenerative pathological processes, constitutes one part of the formula of reaction of degeneration. The laws of contraction vary with feeble, medium, and strong currents.

Chemical decomposition effected by means of electricity is known as electrolysis. Electricity is sometimes employed in the treatment of disease for its destructive electrolytic effect upon tissues, but never in the therapeutics of nervous diseases. It is mentioned here only to warn that no current can pass through the human body without effecting electrolytic decomposition. The amount of electric decomposition will depend upon the quantity of electricity which passes, and upon the nature of the substance that it decomposes. Rapidly alternating currents produce electrolytic effects not only in the medium immediately surrounding the poles or electrodes, but also in the intrapolar area. Long continued application of a strong but not necessarily severe current may cause harmful electrolytic decomposition of the tissues affected without causing any very evident physiological or structural phenomena.

A current of electricity sent through two liquids separated by a porous diaphragm or septum will transport bodily a portion of the fluid through the septum in the direction of the current, that is, from the anode to the cathode. This phenomenon is called electrosmosis or cataphoresis. The human skin, and other tissues that permit organic osmosis, offer similar septa for the production of the phenomena of cataphoresis. It is therefore possible to carry into the body by means of the galvanic current almost any medicament that is capable of solution. An electrode thoroughly moistened with the solution is placed against the skin where it is desired to inject the substance and connected with the positive pole of the battery, while the negative pole is placed over some indifferent part of the body. It has been proposed to introduce the alkaloidal substances, cocaine, morphine, quinine, strychnine, etc., in this way. Although the method has the advantage of permitting a local application to the parts that it is desired to influence, all of these substances, save cocaine, exercise their therapeutic influence through absorption into the general system. Therefore it has nothing to recommend it over hypodermatic injection, and, as a matter of fact, except as a method of employing cocaine for the relief of local pain, it has never come into general use. The electrolytic and cataphoretic action of a current in any portion of the internodal pathway through the body may cause a decomposition and transportation of the chemical constituents of the tissues and thus furnish the material for subsequent reconstruction. Little is known, however, of these complex chemical reactions, and they are at least not as yet controlled to the purposes of electric medication.

The Therapeutic Application of Electricity.—No definite rules can be laid down for the guidance of the physician in the application of electric-

ity for each case. As in the use of all other therapeutic measures, especially non-medicinal ones, individualization is of the greatest importance. The mode of application varies also with the disease that it is desired to influence. This subject will receive detailed consideration in the chapters devoted to special diseases. When electricity is used in the treatment of a peripheral nerve paralysis, such as the facial or the musculospiral, the current is applied directly to the nerve, as well as to the muscles of its distribution. As a rule, the current to which the neuromuscular apparatus is most responsive is the one decided upon. If the inflammatory or degenerative change in the nerve is considerable, the faradic current is to be recommended. On the other hand, when the current is used to influence disease of an organ which is far removed from the periphery, such as the brain and spinal cord, one must decide whether it is advisable to apply the current directly over the affected parts or over remote parts; in the latter event, the distant organs or tissues may be influenced reflexly, or through the conduction of impulses through the centripetal neurons. As a rule, to which there are few exceptions, it may be said that the indications in this respect point to the local use of the current, that is, to the application of a current of certain strength and intensity, directly to or over the parts which it is desired to influence. For instance, in tabes dorsalis the indications are for the application of the galvanic current directly over the spine and the posterior ganglia, and not to the general cutaneous surface with the expectation of causing the current to pass along the centripetal neurons to the spinal cord. This local application of the current to the seat of the disease presupposes an exact diagnosis.

Another feature which calls for the exercise of good judgment in every case is the amperage, or strength, of the current. As a general rule it may be said that the current should not be so strong as to cause pain, nor, on the other hand, so weak that it cannot be felt by the patient. The resistance of the human body under different circumstances is so variable that the amperage required in the treatment of different diseases can scarcely be approximated in figures. Many writers, however, publish the average figures of numerous tests. These are disappointing as a safe guide, and I do not believe it necessary to refer to them. The tendency of beginners in the use of electrotherapy is to use too strong currents, particularly in the treatment of muscle inactivity sequential to inflamed or degenerated nerves and disease of the muscle spindle. It should never be forgotten that electricity is not only capable of causing very disagreeable symptoms, such as flashes of light, vertigo, pain, and syncope, but it may also initiate profound structural changes in the tissues. To avoid the former the greatest care must be exercised in applying electricity about the head and neck. The galvanic current should always be graduated by means of the rheo-

stat, and the current should never be increased or decreased except by throwing in or taking out the resistance by means of this controller. If this precaution to diminish the current by gradual withdrawal of the rheostat piston be neglected and a strong current of electricity be suddenly cut off by removing the plug socket from the switchboard of the galvanic current the patient may experience very disagreeable sensations.

Three methods of application of the differential electrode—the stabile, labile, and interrupted methods—have been mentioned. In most cases, it matters very little whether the labile or the stabile method is employed. Naturally the application of the current for the relief of pain demands as little interruption as possible without the exaggerated effects of continued stimulation of the same part; hence the labile method is to be preferred. On the other hand, if the stimulating effect of the electric current on the muscles is desired, the interrupted method should be used. The electrode may be either intermittently touched to the part and removed or an electrode with an interrupting handle may be employed.

It also follows from the relatively greater reaction produced by the cathode over that produced by the anode that the positive pole of a galvanic battery should be applied to a part that needs quieting as in neuralgia, and the negative pole when stimulation or counterirritation is desired. Upon experience with the diverse effects of anode and cathode has been founded the "polar principle" of galvanic application.

The frequency and duration of the electrical treatment accorded a particular case demand the careful attention of the person who essays to use it. A disease or disorder that calls for electrical treatment at all demands daily application to obtain the best effects. Very rarely is it advisable or necessary to give two applications a day even in a case, such as facial paralysis, when for æsthetic or other reasons the patient is particularly urgent that no trace of the deformity shall be left and is willing to submit to an excessive expenditure of time and money. Beginners are also with difficulty restrained from unduly prolonging the sitting. In the use of electricity for the restoration of function of the neuromuscular apparatus the current should never be applied for longer than five minutes, and, as a rule, one-half that time is better for its application to an individual nerve. When the current is applied to one of the viscera such as the stomach, or to the spinal cord, from five to ten minutes is quite sufficient. In using electricity to combat the progress of the dystrophies, a few minutes should be spent in applying the current in labile fashion over the belly of the muscle, and then the muscles should be stimulated to mild contraction a few times, not more than eight or ten. For general faradization twenty to thirty minutes are required.

The term general electrization or general faradization will occasionally be met in future chapters. The indications for its use are usually a low-

ered condition of nutrition and vitality, as in neurasthenia and neuralgia of constitutional origin. It is applied by having the patient stand or sit upon an electrode connected with the cathode pole, while the positive electrode is rubbed over the different parts of the body successively in methodical fashion. When the faradic current is used, the patient may place the feet in a basin of warm water in which the negative pole is placed, while the physician holds the electrode of the other pole in one hand and applies the electricity to the different parts of the patient's body with the other hand, the current thus traversing his body before it reaches the patient. This method of applying the current is often very grateful to the patient and is used with effect by charlatans. It is to be recommended in applying the current to a very sensitive part of the body, while the extremities may be rubbed with the ordinary sponge electrode or with the roller electrode. The tonic effects of general electrization are both immediate and remote. The patient experiences a feeling of well-being and of renewed strength after a séance, which may, of course, be due to a psychical influence. Usually after a series of applications more remote beneficial effects appear, such as increase of appetite and improved digestion, less easily induced fatigue, refreshing sleep, diminution of pain and local cramps, and greater capacity for mental and physical work.

General galvanization does not appear to be as serviceable as general faradization, although it may be used in the same manner and to meet the same indications. Beard described a form of central galvanization which is not infrequently recommended in the treatment of hysteria, neurasthenia, hypochondria, chorea, and other neurosis. The procedure consists in placing a large flat electrode connected with the cathode over the epigastrium, while a small electrode connected with the anode is placed over the middle of the forehead, then over the parietal region, then between the ears, remaining in each place for one to two minutes, while a weak current is allowed to pass. At the end of the sitting the anode is applied in labile fashion over the vagus and sympathetic nerves on each side of the neck for from two to five minutes and then over the spinal column for about the same time. Personal experience of its application in these conditions does not warrant its recommendation with any considerable assurance.

The electric bath is one of the most satisfactory methods of general electrization, as it brings all parts of the body simultaneously under the influence of the current. It has a general stimulating and tonifying effect upon the patient, which manifests itself in increased appetite, feeling of vigor and vitality, and refreshing sleep, particularly in neurasthenic and myasthenic conditions. Any bathtub well filled with water may serve to give the electric bath. The current should be turned on after the patient has entered the water, otherwise the shock will be dis-

agreeable. Both electrodes may terminate in water at opposite ends of the bath, or one may be attached to some part of the patient's body. The latter method is very serviceable in the use of the local bath to apply the current to the extremities, in cases of poliomyelitis. It is then not necessary completely to disrobe the patient, and the hydro-electric bath may be given in the physician's office or at dispensaries. The temperature of the water is a matter of indifference so long as it is comfortable. It is not advisable to add salt to the water, because of the corrosive action on the electrodes. The intensity of the current and the duration of the bath must be decided by the circumstances in each case. A bath of short duration and slight current intensity is refreshing and energizing, while one of long duration and considerable current intensity calms and induces rest and sleep.

Static or franklinic electricity is of less service to the electrotherapist than is either the faradic or galvanic. Given in the form of so-called electrostatic air baths, the head douche, the sparks, or by contact with the clothed body by means of the roller electrode, it may assist in combating some of the neurasthenic manifestations, such as head pressure, paræsthesiæ in various parts of the body, and myasthenia. Because of the impression that it makes upon the mind of the patient, it is sometimes useful in dispelling hypochondriacal ideas and feelings. The sparks administered vigorously often cut short hysterical symptoms, such as hysterical anæsthesia and analgesia. They are also employed to cause contraction of muscles functionally disabled through remote lesions, as in hemiplegia of cerebral apoplexy.

The diseases of the nervous system in which electricity can be employed with more or less prospect of relief are comparatively few, despite the fact that at one time or another its use has been recommended in almost every disease of this important system of the body. For purposes of convenience these diseases can be classified as follows:

1. Diseases of the nerves: (*a*) Functional (neuralgia and spasm); (*b*) organic (inflammations and degenerations).

2. Tabes and the sequelæ of inflammation of the ventral gray matter of the central nervous system (poliomyelitis spinalis, poliomyelitis bulbi, polioencephalitis).

3. Neuroses, especially those dependent upon or associated with profound perversion of the sympathetic nervous system; neurasthenia, exophthalmic goitre, acroparæsthesia, and hysteria.

4. Dystrophies and inactive states of the muscles due to local or distant lesions, as in hysteria, hemiplegia, and fixation atrophy, local cramps and exhaustion.

The application of electricity to each of these conditions will be considered in future chapters.

CHAPTER IV.

MASSAGE.

Massage, the art of applying pressure and stress to the soft tissues, is a therapeutic procedure that has gradually wrought its way to the fore as one of the valuable aids of modern scientific resource. The use of massage to overcome fatigue, to promote recovery after injury, and to cure disease antedates the history of medicine. In the days of Hippocrates and of Galen a high degree of perfection was reached in the manner of its application, and the results it seems were correspondingly satisfactory. During mediæval times it fell into disuse and disrepute. It is only during the last quarter of a century that it has been allotted a place as a legitimate therapeutic agency. Even now its use is largely in the hands of persons whose mental endowment and training allow them to make claims for its usefulness which to even a tyro in physiology and pathology are absurd, and whose conception of pathological process is so sterile that they publish cures which surpass human understanding and approach the supernatural. The claims of such individuals not only prejudice many of the faculty against its use, but makes them loath to accept the statements and claims of others, more worthy of being listened to, concerning its efficacy in the treatment of disease. Originally founded in empiricism, and for many centuries basing its claims for acceptation as a therapeutic agent upon experience and tradition, massage has latterly come to stand upon a solid foundation of experimentalism, so that to-day its use as a curative agency is as legitimate as anything can possibly be.

Estimation of Its Worth in the Treatment of Nervous Diseases.—Massage does not occupy a very important place in the therapeutics of nervous diseases, nor does it have, needless to say, any specific action in counteracting pathological states of this system. In attempting to estimate its value in the treatment of nervous diseases, it may be said that its usefulness is restricted to quickening the lymph and blood circulation and to stimulating tissue metamorphosis, secretions and excretions, thus helping to maintain nutrition and to restore it when disordered. In like manner, it promotes the absorption of pathological products mainly, if not entirely, through its effect upon the interstitial circulation. Acting directly upon the terminals of the sensory nerves, a sedative or exciting influence may result. It is within the bounds of scientific possibility that such impulses may, on being conducted centripetally, have an influence upon the central neural apparatus.

Its usefulness in nervous diseases may, therefore, be considered under three heads: (1) As a general tonifying agency; (2) as a stimulant or excitant of muscular tissue; and (3) as a sedative. The first of these is by far the most important, for we have other agencies that are more available and more reliable for the other two purposes. In nervous diseases massage is used as a tonifying agency to replace exercise when the latter is impossible or inadvisable. Thus, it is used in locomotor ataxia, neurasthenia, hysteria, and hemiplegia, to stimulate the vascular and lymphatic currents, to furnish gentle vasomotor and trophic excitation and thus aid physiological metamorphosis; to maintain suppleness by preventing changes in joints which lead to their immobilization, and to stretch newly formed connective tissue. The most satisfactory method of massage to accomplish such aims is that which will be described later as general massage. Massage is used to stimulate or excite muscle tissue; to overcome myasthenic states of the abdominal viscera, particularly the large bowel; to tonify relaxed voluntary muscles, as in neurasthenia and hysteria; to stimulate muscle fibres undergoing atrophy from enforced inactivity, and to stay the course of inherent pathological changes in the muscles, such as take place in the dystrophies. The procedure that best accomplishes the end in such conditions is that of striking, chopping, or pounding.

As a sedative, massage is used to induce sleep, either through influencing the intracranial circulation by means of throat stroking, or by inducing a degree of relaxation and well-being that will be conducive to repose by means of general massage. As a pain reliever, it is used in the shape of rhythmical beating or percussion to the nerves that supply the area in which pain is manifest, and by stroking and kneading to relieve venous engorgement and counteract inflammatory conditions. The former is of service in neuralgic conditions. The recurring taps or percussions of equal intensity tend to produce an anæsthetic state of the nerve to which they are applied. The various mechanical percussors that have been devised are based upon this principle. Stroking and kneading are useful particularly in overcoming pain of localized neuritis and perineuritis which is often the morbid anatomy of sciatica. The therapeutic worth of massage depends entirely upon its fulfilling the above outlined indications. That it can do so every one who has had sufficient experience to entitle him to an opinion will admit. This will not prevent him from the admission, on the other hand, that the physician may avail himself of other means which excel massage in meeting one or another of these indications. Therefore massage is a remedial agency that should seldom be depended upon exclusively to bring about a cure. At best, it should be considered an auxiliary of other non-medicinal therapeutic agencies, such as hydriatics, electricity and dietetics, and of medicines. The fact that it requires no apparatus or paraphernalia for its use and that any intelli-

gent person may soon acquire the dextral proficiency necessary to apply it, providing he has the strength, is one of its leading recommendations. Another is that the results of its use in certain conditions have been shown to be satisfactory by numerous trustworthy observers.

The Mode of Applying Massage.—Massage may be given either by the hands or by some mechanical device. Aside from those constituting the mechanisms of vibratory therapeutics, the latter may well be considered under medical gymnastics. Manual massage consists in the use of stroking, rubbing, kneading, pounding, striking and slapping, to which the French terms of (1) effleurage (stroking); (2) frictions (rubbing); (3) pétrissage (squeezing or kneading); and (4) tapotement (striking, tapping, pounding), are commonly applied, especially by professional masseurs. These designations are likewise commonly used in special monographs on the subject. Feeling as I do that massage is tending toward formalism, and to its great disadvantage, and convinced that it is in reality the simplest form of mechanical procedure, no further reference to these French designations will be made.

Stroking is one of the most useful manipulations of the operator. Its beneficial effect depends upon its capacity to quicken the circulatory fluids, and therefore indirectly to stimulate the processes underlying nutrition. Stroking consists of just what the name indicates—of applying the palms, the approximated thenar and hypothenar eminences, the volar surface of the thumb, the tips of the three first fingers, or the ulnar border of the hand to the part that it is desired to influence, and stroking it in the direction of the venous current with greater or less pressure, according to the amount of vascular change that it is desired to bring about. It is to be remembered that the movement is always centripetal, no pressure being given in the return movement. Delicacy of touch rather than strength is essential. One or both hands may be used, depending upon the size of the parts that it is desired to massage. As a rule, it may be said that it is preferable to use one hand. In nervous diseases, stroking is useful to overcome the myasthenia and easily induced fatigue of the neurasthenic; to increase the nutrition in inactive parts, whether they be the seat of local disease such as dystrophy, or whether the inactivity be the consequence of disease in the spinal cord such as inflammation or degeneration of the ventral gray matter; and to absorb inflammatory exudate in the sheaths of the nerves, or in their more remote environment, the muscles. Stroking is an important integral part of the manœuvres known as general massage.

Rubbing, or superficial friction, is a method of applying massage that is of comparative insignificance in the treatment of nervous diseases. Its only real use is in facilitating the absorption of exudate in the sheaths of the nerves, and in local myositis. The procedure consist sin pressing with the tip of the thumb or the tips of the first three fingers, with a circular

movement. The size of the circle depends upon the area that it is desired to massage. If the object is to influence deep structures, very great pressure is necessary, and there is no procedure that taxes the strength of the operator to a greater degree. The massage should be given first with one thumb and then with another. Some operators are able to use the thenar eminence for the same purpose and with equally good results. If the object of rubbing or friction is to facilitate the absorption of the superficial exudate, the pressure is naturally of less severity. First the skin is moved independently over the area, and then the skin and superficial tissues are moved simultaneously.

Squeezing and kneading of the tissues is one of the most important features of general massage, and therefore one of the most useful varieties of massage movements. The tissues are grasped with one hand or both hands, depending upon the part and its volume, and subjected to kneading, squeezing movements done in rhythmical fashion. Here again it depends largely upon the tissues that one wishes to influence how much pressure shall be applied. The object as a rule is to increase tissue-metamorphosis, and so to influence not only the local but the general nutrition. It is frequently necessary to use quite as much force as the strength of the operator will permit. The patient oftentimes objects strenuously to this feature of the treatment. This movement is an important agency in replacing exercise during the rest cure in neurasthenia; in preventing the excessive deposition of adipose tissue in many lithæmic patients, especially while taking a rest and dietetic cure; and in increasing the strength of the abdominal muscles. It also is one of the principal features in abdominal massage.

Striking or percussion of the skin and muscles with the flat hand, the ulnar border, or the tips of the fingers, is an important procedure of massage, owing to its capacity to stimulate muscular contraction and to increase the mechanical irritability of the nerves. It is often done in Zander institutes, and mechanico-therapeutical institutes, by means of rubber hammers or mallets, operated by machinery. The advantage of these is that the intensity of the blow may be carefully graduated, while the rhythm is of mathematical regularity. But this is outweighed by manual beating of the skin, in which the results of each blow can be at once seen. Muscle beating is of service in overcoming the myasthenic state in many of the neuroses, and when done with care it should be tried in the progressive dystrophies of slow course. It is likewise an available means of counteracting inactivity muscular atrophy.

The general indications for each of the above procedures have been already considered. Their application must vary not only with the disease for which they are to be used but with the individual. Many nervous patients are so erethistic and irritable that they will not tolerate kneading or muscle beating of any considerable severity. On the other

hand, there are individuals of phlegmatic disposition, suffering from loss of neuromuscular energy, who are soothed and rested by such applications. One must be guided largely by the general indications and by the outcome of trial. All of the above-mentioned procedures are often combined, as in general massage, which is a variable procedure, depending upon the operator. It may consist of stroking of first one foot, followed by kneading and a few sharp strokes with the ulnar border of the hand, ending with a number of passive movements of the joints; and then a similar treatment of the other foot, or one entire extremity may be finished before passing to the other. It matters not which plan is followed, the details are practically the same. After the lower extremities are finished, the upper extremities are treated in similar fashion. Then the trunk is stroked, kneaded, and tapped, beginning with the dorsal surface, followed by massage of the thorax, and then abdominal massage, the séance ending with stroking of the throat and the sides of the neck, especially if it is desired to influence the patient to repose and sleep. If the object is to stimulate the patient, and to have the treatment act as an immediate tonic, the séance should terminate with vigorous general striking of the trunk and extremities with the palms or the ulnar borders of the hands.

Abdominal massage is often very efficacious in overcoming the relaxed condition of the abdominal wall, and constipation due to sluggishness of the muscular coat of the large intestines and deficiency of intestinal secretions. The patient lies on the back, with the thighs semiflexed and the abdominal walls relaxed. The operator applies rubbing or friction in the way above described, taking up the different parts of the abdomen in succession, but making particular effort to apply severe pressure over the three divisions of the colon. This is followed by squeezing and kneading movements applied gently to the superficial parts, and with about all of the force possible to the deeper parts, then by vigorous abdominal beating. The séance lasts at least one-half hour. The method of procedure in throat massage has already been sufficiently described.

The Séance.—The mode of applying massage is not all-important, although naturally there is a right way and a wrong way. The professional masseur, who, after stripping his patient, walks about him and takes a general survey, at the same time liberating some of the information which comes to him through his critical eye and which seemingly astonishes him or confirms him in a previous belief, or who limits his comments to a repeated "Ah, yes," "I see," etc., etc., while at the same time he makes ready to begin by indulging in several passes through the air, hurriedly putting a joint through a few turns, or raising an extremity and letting it drop, apparently to see with what force it will fall, should be dismissed at once. He may be a good masseur, but he is far too superior a personage for the ordinary patient, and if not eliminated early from the case is likely to have a demoralizing effect upon the pa-

tient that will more than counteract any benefit that might be derived from the treatment. Judging from my own experience, especially with male masseurs, of whom this country would now seem to have more than a utilizable number, especially those with diplomas and certificates of proficiency from unknown and unheard of Scandinavian institutions, the study and practice of massage by those ignorant of the simplest principles of physiology seems to be very conducive to the development of mannerisms and overweening self-importance. There is scarcely an occupation to which such ancillæ are not more becoming. In this country, it is not the custom for the physician to give massage treatment himself, although there is no reason why he should not do so except a lack of time. He should, however, have such theoretical knowledge of the subject and of the ends in view as to be capable of directing the procedure. It would be an advantage if he were possessed of the manual skill necessary to give it as well. Massage operators, unlike poets, are made, not born. There are no special requisites to fit one for such an occupation, save a fair endowment of strength and undeformed hands of fairly good size. If these are associated with a moderate amount of intelligence, particularly in the line of amenability to instructions and obedience to orders, the operator is complete.

The patient should be prepared for general massage by being stripped, wrapped in a covering in keeping with the atmospheric temperature, and put in a comfortable position, preferably on a resistant surface. Mediate massage, that is massage through the clothing, is recommended by some authoritative speakers on this subject, but it does not seem to me a rational procedure for manual massage. In the application of mechanical massage it apparently matters not at all whether the skin is lightly covered or not. The members are exposed in succession, and covered as they are finished. If the massaged part is of considerable surface, and particularly if rubbing and kneading are to be employed, it is very essential that a small amount of lubricant, such as lanolin, be used. The position taken by different writers on massage about the use of lubricant is nothing less than ridiculous. One author states that fresh hog's lard is the best, another that it is the worst; one writer maintains that vaseline is the ideal lubricant, another that he can scarcely imagine the pressure that would compel him to use it. As a matter of fact, the best lubricant is the one closest to hand, providing that it is neither æsthetically nor cutaneously offensive. Care must be taken not to use the lubricant excessively, for then the hand will glide over the part and the operator be unable to massage it with sufficient stress. Another precaution that should not be neglected is to shave the part if there is considerable hirsuteness or if the application of massage causes pain by dragging upon the few hairs of a given area. In this way one will avoid not only causing the patient pain and sequential erethism, but there will be no danger

of the séance being followed by inflammation in the hair follicles. Individual parts should rarely be massaged longer than fifteen minutes, and often one-third or one-half of this period is sufficient. General massage should last at least one-half hour. It depends entirely upon the individual and the condition that the operator is striving to overcome, how severe the treatment shall be. Massage operators very often make the mistake of giving the treatment with entirely too great severity, especially in the beginning. A general rule applicable to all forms of mechanical therapy is that tolerance is acquired slowly. Therefore, the first few treatments should be mainly to prepare the way, and not to frighten the patient or to make him so uncomfortable that he dreads a second visitation or receives it against his will. In the application of massage for the treatment of nervous disease the operator should never leave any signs of his visitation.

The individual applicability of massage and the indications for its use will be spoken of in detail in discussing the treatment of the individual diseases. Here it may be said that it is of service particularly in such neuroses as neurasthenia and hysteria; in such organic spinal cord diseases as infantile paralysis and tabes, in single or multiple disease of the peripheral nerves, particularly if the inflammation is of low grade and of slow development, and in the various immobilities due to encroachment upon or interruption of the motor neurons. Finally, it is of service as a general tonifying and sleep-producing agency in a number of conditions.

Medical Gymnastics.—Treatment by movement or medical gymnastics is frequently used in connection with massage to supplement the effect of the latter. The benefit of such movements is due to their action upon the circulation, the digestion, the respiration, the absorption, the secretions and excretions, in brief to their effect on metabolism and constructive metamorphosis. They are performed in one or the other gymnastic postures, standing, sitting, or lying, which are further subdivided according to the particular form of exercise.

Medical gymnastics are divided into passive and active movements, both of which are performed upon all of the different joints.

Passive movements are used in immediate connection with massage, usually being given as a part of the séance. For instance, after a part, such as an arm, has received massage by means of stroking, rubbing, tapping, as the case may be, the treatment is concluded by passive movements applied to the joints of the fingers, wrists, elbow, and shoulder. These are of course done by the operator independently of any effort or will on the part of the patient. Similar treatment is applied to all of the other joints in turn, or to any one of them as occasion demands, the different movements used being adapted to the different joints and to the individual need of the patient. The passive movements to which the various joints are subjected are referred to as extensions, flexions, rota-

tions, supinations, and pronations, used according to the nature of the joint involved and so varied as to get the particular kind or degree of exercise desired. In addition to their ordinary use as exercise, such movements are of particular service in certain cases of stiffness of joints and of weakness following prolonged inactivity, by gradually adding suppleness and strength, thus preparing them for more active exercise. The movements vary greatly in strength and rapidity, usually being applied cautiously at first and increased gradually according to the strength and endurance of the patient. Active movements consist of single and duplicated or resistance movements. The former are done by the patient alone and the latter by the operator while the patient resists, duplicated eccentric movements, or by the patient while the operator resists, duplicated concentric movements. These bring into play the same joints as the passive movements, but offer greater variety and force of action. The greatest advantage, however, to the patient who is able to perform them, lies in the fact that, being voluntary action, they require an effort of will on his part. By means of flexion, extension, abduction, adduction, rotation, and circumduction performed singly or in combination, and with or without resistance, an indefinite variety of movements is obtained which can be adapted to the different joints and to their individual needs and capacities.

In addition to these exercises for the joints, there is another set of active movements intended especially to aid respiration. These are performed by the ribs and include lifting and expanding the chest, flexion and extension of the arms with resistance, extension and flexion of the spinal column with resistance, etc.

The system of Swedish movements invented by Ling is one of the most popular in use for the purpose of medical gymnastics. It includes all of the principal movements which are of service in this connection and admits of a wide range in the matter of the variety and intensity of the exercise. It is divided into two forms of movement, those done with and those without apparatus, the latter admitting two postures, standing and suspension. These movements are in reality much more simple and easy of comprehension and application than the detailed descriptions of them in the manuals on the subject would suggest. The apparatus employed is also of comparative simplicity.

In the Zander system we have another method of applying medical gymnastics which requires much more complicated apparatus for its execution. The outfit consists of such mechanical devices as rowing, bicycling, riding machines, and the like, run by steam to which the patient offers resistance; also of other similar machines by which the patient receives passive exercise. Properly applied, these movements are often of considerable service in the treatment of nervous diseases, especially the functional neuroses. They not only give the requisite exercise, but the formality of

the appliance and the intricacy of the machinery are calculated to impress the more forcibly the mind of the patient and therefore the better to elicit his interest and will power. When, however, a properly equipped institution is not at hand, it is necessary to have recourse to one of the more readily available methods.

CHAPTER V.

EXERCISE, REST, AND OCCUPATION.

There are few factors that are more conspicuous in the causation of disease than neglect of exercise. In olden times, exercise of the body resolved itself into comparatively simple considerations. The nearer man lived to a state of nature, the simpler and more spontaneous were his exercises, tastes, and habits; therefore the more conducive to the soundness of health. The childhood of the race, like the childhood of the individual, found life a simple, not a complex problem and therefore more easily mastered so far as its own needs were concerned. But as the child-man advanced it became necessary, in order to meet the increased demands put upon him, to cultivate intellect and wit in proportion as he lived more by these and less by brawn. The results show that it was often done at the expense of the body. Insufficient and improper exercise is one of the commonest causes of disorder of nutrition. Since exercise is known to be so necessary to the maintenance of health and since it is such a simple measure within the reach of all, neglect of it is the more surprising. However, habit and expediency are two of the strongest influences in shaping the life of the average individual, and unfortunately for him, there are many situations in life in which neither the one nor the other favor expenditure of time and energy in what appears to be an unprofitable way. The immediate and remote effects of methodical exercise upon the body is well known. It makes the muscles firm and vigorous, it tones the circulation, deepens respirations, and insures the proper functioning of the tissues of the body. The want of it leads to flaccidity and debility of the muscles, stiffness of the joints, sluggishness of breathing, and, in brief, depression of all the vital functions.

The importance of open-air exercise in the development of the youth is universally admitted. The majority of the so-called leisure classes indulge in some form of athletic sport or physical recreation. Of late years there has been a gratifying revival of athletics, particularly in connection with the education of youth, and we may expect to witness even more conspicuous beneficial effects in the succeeding generation than in the present one. But it is in the great masses, the brain workers, men overtaxed with business cares and women with domestic duties, that the need is most pressing and the results of lack of exercise most startling. It is so easy to let the hour's fresh air and exercise be crowded out by the things which they feel bound to do for the sake of themselves and others. In

their endeavors to meet the complex demands of modern civilization, they often forget the simple rules of right living. The truth is that, owing to the complexity of their circumstances, occupations, and environment, the application of these rules, simple as they are, is not so easy as is the recognition of them. The average busy man or woman finds all exercise, except a little desultory driving or walking, as far removed from his or her ordinary mode of life and its exigencies as are the luxuries of the rich or the sports of childhood. Instead of being a necessity of one's daily life, exercise is resorted to only when the vigor of the body has become wasted and when illness supplants health.

It is unnecessary to consider in detail the manner in which exercise acts to maintain a state of nutrition inimical to disease, and to facilitate the restoration of nutrition which constitutes the cure of disease, for this is a matter of physiology that is well known. Briefly, exercise promotes constructive metabolism, by causing increased activity in the processes of combustion and a demand for the combustibles, and also by ridding the system of effete products the retention of which, even in small quantities, might become extremely injurious. All physical exercise causes the consumption of fuel—food-stuffs that have become an integral part of the organism after absorption—which constitutes the tissue change forming the basis of metabolism. This consumption causes a proportionate loss of weight which in turn creates a demand for material to replace it, in other words, for food. To aid in removing the waste products is an important element. It is very easy to see that the more readily the old particles are destroyed and removed and the fuel renewed, the more vigorous will be the process of metabolism. The physiological activity and constitutional vigor of every cell are in direct relation to the activity of metabolic change that goes on within it. If the process is excessive, nutrition will be imperfect because waste will then exceed repair. On the other hand, if the process be insufficient, the waste products will fail to be removed and not only will the metabolic functions become clogged to the exclusion of new and wholesome fuel, but there will be an accumulation of material whose presence is detrimental to the economy. In this state, the food, it matters not the amount or quality, fails to nourish the body and to give tone to the muscles and nerves. Indeed, it often adds to the accumulation of waste products. The result is that profound disturbance of circulation and nutrition which is at the bottom of so many nervous diseases.

Sports and Gymnastics.—Physical exercises may be divided into two kinds: first, those in which the general plan and the final object to be attained are definitely indicated, the movements themselves being left to the choice of the individual; and second, those in which the movements are accurately planned, their force, duration, frequence, and form being determined by strict technique and carried out systematically. In other

words, it may be considered under sports and gymnastics. There are, of course, many occupations that afford much purposeful and healthful exercise, but as these require that thought and effort be directed toward the end and little toward the manner of their execution, they may for practical purposes be included in the first division.

In order that exercise be effectual it must call into activity the mind as well as the muscles, and it must be so selected and arranged as to be adapted to the peculiar mental and physical condition of the individual. It is easy to understand that the kind of exercise which will interest and benefit one person of certain age and position in life will be entirely unsuited to another under different conditions. In a similar way, the same form and degree of exercise is not recommended for him who is suffering from the results of excessive mental application and for him whose condition is the result of acute disease. Hence the superiority of what may be called spontaneous exercise well directed over merely perfunctory walking or driving for health, and gymnastics done in routine fashion with no particular meaning or method as to their execution. Ideal exercise is that form in which the greatest general play of muscles is obtained with the least studied effort. For this reason the different sports are immeasurably preferable to systematic gymnastics. They afford that form of exercise which approaches most nearly to the natural and spontaneous and to the exercises of childhood. Their virtue lies not only in the exercise of the body but in the appeal which they make to the mind and their power of maintaining interest and eliciting the direction of will with the least conscious effort. As a rule, they also bring into simultaneous action a number of different muscles, thus generalizing the exercise and its beneficial effects.

Determination of the kind of sport that will be most expedient and beneficial in a given case will depend upon temperament, station, habits, degree of physical strength, and nature of the individual's infirmity. At the present time the field of active sports and athletic exercises cover so wide a range it would seem that some suitable form must be quite within the reach of the average person. Walking, the most natural of all exercises, and long-respected remedy for many ills, is rather an exercise of the well man than of one who is ill. To be of considerable service, walking must be brisk, active, and prolonged, and there are many reasons why the prescribed walk of the nervous invalid, taken in the same spirit as a teaspoonful of ill-flavored medicine, will scarcely be of any use. A fairly safe rule to follow is that so long as walking is spontaneous and refreshing it is beneficial; carried beyond this, especially if it is irksome to the patient, little or no good can be expected.

Bicycling has come to be reputed as one of the most valuable exercises in the prevention and cure of disease. Its greatest merit lies in the fact that it appeals equally to the sexes, and to all ages and conditions.

Moderation in its indulgence and a properly adapted and well-fitting saddle are the two things that the physician should insist upon, and especially for women. Carried to the point of exhaustion, it is decidedly injurious. It must be recommended with great caution to those who have organic disease of the vascular system.

Of all the games that lend themselves to the neuropath, golf is the most favored. It has a larger field of usefulness in the treatment of nervous disease than any other form of athletic sport. It comes within the physical reach of a much larger number of people than any other game and it has the signal advantage of affording pleasant activity to the mind as well as to the body. Moreover, there is scarcely any danger of over-exertion as there is in so many other forms of exercise. Unfortunately there are many social and financial restrictions around the game in this country so that comparatively only a few can avail themselves of its advantages. Tennis affords splendid exercise for the well person, and it can be indulged in most profitably by many sufferers from functional nervous disease, especially those in which the mental element is conspicuous.

Of the milder forms of exercise, rowing is one that can often be recommended with safety, even to the very frail. The movements are very general, bringing into activity a large number of muscles and not putting individual muscles or groups of muscles under special strain. In fact, almost all the aquatic recreations may be taken into favorable consideration in the treatment of many functional and organic nervous diseases. Even fishing, if it be sufficiently absorbing to hold the attention of the individual, may be recommended. For much the same reason, mountain climbing and donkey riding, when there is some special object or destination in view such as a search for wild flowers and birds, or when the person is a sufficiently enthusiastic admirer of nature to find pleasure in the mere contemplation of her wonders, are also beneficial. Shooting, hunting, and the many other sports which the country affords need no special mention. It is usually in consequence of the limitations of city life that the greatest difficulty is found in hitting upon the particular variety of exercise which is suited for a particular case, but the walk, the drive, the ride, the bicycle, the deliberate open-air breathing-spell on the front platform of a street car, some one or all of these is within the means and opportunities of every busy worker, male and female. Fencing for those who have the strength to indulge it, is an important exercise because of the bodily and mental discipline which it affords. The same may be said of a much milder exercise—hand-ball. Riding and driving belong in the list of so-called passive exercises. This is particularly true of the latter, but both of them have their uses. But here it may be said that latterly it has become the custom to decry riding as excessively violent and injurious for women. Like bicycling, it can undoubtedly be made so if carried to excess, but

when taken moderately and understandingly by a person who enjoys it, there is scarcely any exercise which has a more exhilarating and at the same time soothing effect on both the body and the mind. Those who complain of great fatigue following a moderate ride should submit to careful examination and instruction before making further tests of their endurance. When wrongly done the effects may be decidedly injurious.

Gymnastics.—The rôle of gymnastics in the treatment of nervous disease is somewhat different from that of sports, and as neither one can altogether replace the other, they are often recommended simultaneously. Sports tend to the production of general effects, while gymnastics, on the other hand, have primarily a local action on particular groups of muscles, although the general system may benefit indirectly. They require for their performance concentration of the attention upon them and are consequently often irksome. As the different movements are arranged on a scientific basis to meet certain indications, and as they are usually carried out under the direction of some one who understands their proper application, it is a comparatively easy matter to find the ones best suited to the needs of each case. The important element is the localization of effect to one set of muscles at a time. This is then shifted to another, and in this way all parts of the body, or as many as may be desired, receive in turn the particular kind and amount of exercise that has been decided upon. This method of localization secures to gymnastics proper the advantage of more intense muscular effort than do more spontaneous exercises. Such an end is often of great necessity in certain diseases in which it is desirable to obtain considerable activity in certain parts of the body, without causing general disturbance which it may be advisable to avoid.

All movements coming under the head of gymnastics can be divided into passive and active movements. They are done with or without apparatus, but the latter have the decided advantage of affording a greater diversity of scope and a tangible form in the nature of a "cure," on which the mind of the patient can readily fix itself. The appeal which it thus directly makes to him is of much importance. The varieties of gymnastics vary in form and intensity from those which require the least possible output of carefully guarded strength to the most violent forms of exercises, such as leaping, vaulting, and running. However, the latter need not be further mentioned in this connection, as their indulgence demands a degree of vigor which is not compatible with considerable disorder of the nervous system. The system of gymnastics most favored in the treatment of nervous diseases is that known as the Swedish. Here the movements are so mild that they are applicable to nearly all cases in which the object is to aid restoration of nutrition and to relieve the tension of overstrained nerves by affording gentle activity to the weakened muscles and engrossing occupations of the mind.

In considering the use of gymnastics in the treatment of nervous dis-

eases, the question naturally arises to what extent are beneficial results that follow indulging in them due to the physiological effect of exercise, and to what extent to the psychical influences exerted by them upon the suggestible mind of the patient. It would be a difficult matter indeed to draw an exact line of differentiation. Of the definite physiological effects and of the benefit that accrue therefrom there can be no doubt. As the psychical effect, however, we have to deal with a subject which is much more difficult to explain, although its results are apparent to every one. To many patients it is one of the means of introducing the leaven of energy of which they stand sorely in need, and it may fill an important niche in a despairing life of unrelenting invalidism. This psychical influence is an integral part of all therapeutic agencies and one that cannot be neglected.

Rest in the Treatment of Disease.—Unlike the hygiene of exercise, that of rest, except in its most natural and primitive sense, is of comparatively modern application in the treatment of disease. True, the saying that "sleep is better than medicine" has been current in all times, but as the necessity of sleep in the maintenance as in the recovery of health is self-evident, it can scarcely be considered from the point of view of science. Enforced rest, in connection with relative isolation, is now generally conceded to be one of the most essential measures in the treatment of neurasthenia and hysteria, and of very great service in many of the functional and organic nervous diseases. The systematic plan of treatment that has been devised for carrying it out is known as the Weir Mitchell rest cure, after its distinguished originator. It consists essentially in forced feeding, rest in bed and isolation for a period of time lasting from one to two months, and in the utilization of physical and medicinal measures that contribute to improvement of nutrition and restoration of mental equilibrium. The mental influence of the isolation is unquestionably the most important factor of the rest cure. It is customary to speak of a complete and a partial rest cure. In the former the patient is put to bed in a properly selected room and required to take absolute rest. Writing, reading, and all diversions are forbidden. The patient is, however, not left to the contemplation of his or her own miseries. On the other hand, the time is carefully allotted with a view to the avoidance of such thoughts. The schedule consists in frequent and regular feeding, the use of water, massage, exercise, and electricity. The remainder of the time is spent in sleep and being talked or read to by the nurse. The complete rest plan is required in a relatively small proportion of all cases of neurasthenia and hysteria. In the less severe forms, particularly if they have not been already subjected to considerable treatment, other measures and a partial rest cure suffice. Under no conditions should it be decided upon until the physician is reasonably certain of the ability, both on his own part and on that of the patient, to carry it out with the conformation to minute detail which is

one of the essential elements of its success. The method of the treatment is based upon the idea of system, and this fundamental principle cannot be ignored to any degree without materially forfeiting the chances of success. This point cannot be too strongly urged in the use of every plan of treatment for the relief of any chronic nervous disease in which the selection of the mode of treatment must be determined to a great extent by the individuality of the patient, but in which the mode of application, once determined, admits of no compromise. In the fulfilment of these two conditions lies the severest test of the physician's power to cope with the disease. It presupposes the capacity of individualization in the finest sense, for it by no means suffices that he possesses the ability to point out the best mode of treatment adapted to a given disease or patient unless this knowledge be supplemented by the capacity to carry it out. The application of the rest cure should not be decided upon until the patient understands and accedes to the conditions which it imposes. All patients start out with the conviction that the treatment is not adapted to them. To a few it is injurious. To the many it is beneficial. The tactful physician will separate the one from the other. When it is once undertaken it is to be carried out without any considerable omission of detail, but of course with modifications to meet the mental status particularly of the individual case.

The indications for the use of the rest-plan of treatment are difficult to lay down categorically, but it may be said that the majority of the cases which are benefited by it are neurasthenic and emaciated patients who have been brought to this state by neuropathic disposition and manifold injurious influences acting upon their general nutrition and the sources of their nervous energy.

The more complete and extensive the psycho-pathological manifestations of disease are, that is, the more conspicuous are hypochondria, anxiety, and depression, the more uncertain are the beneficial effects of the treatment. It is far more successful in the treatment of acquired neurasthenics than what may be called constitutional neurasthenics. Every one who has had much experience in the use of the rest-plan soon learns to be chary in promising complete cure or even permanent amelioration to this class of patients. Moreover, it is early impressed upon such a patient that improvement in the body does not always go hand-in-hand with benefit to the mind.

The object of the rest-plan of treatment is to improve nutrition and give mental and bodily rest. The enforced rest prevents expenditure of energy while the proper use of food and physical measures, such as massage, passive gymnastics, hydriatics, electricity, bring about the improvement of nutrition necessary to recovery. The value of these physical measures in the rest cure varies with the individual. No two cases accept just the same form of treatment. The importance of the part

played by massage can be overestimated if we attempt to lay down any specific rules. If absolute rest in bed is prescribed, massage in some form to aid constructive metabolism is necessary. Massage prevents the enforced rest from having injurious consequences upon the muscles themselves, by increasing the general and interstitial circulation, thus favoring tissue metamorphosis. It increases the tonus of the gastro-intestinal tract, and thus contributes greatly to the increase of nutrition and indirectly to the excretion of incompletely digested and absorbed products. By many it is supposed to have an influence apart from these conditions. Binswanger, for instance, is of the belief that a certain amount of uniform manipulation of the skin over a large surface of the body causes stimuli to be sent to the cortex of the brain which have a direct sedative influence. Slow, uniform, moderately firm rubbing of the entire cutaneous surface, without particular pressure or kneading of the muscles, has a peculiarly soothing effect upon many patients. When it is found advisable to use general massage, the pinching and kneading of the muscles, followed by massage of the skin, is most advantageous. Massage is applied to all parts except to the head, which is generally best left untouched, unless there are special indications for its application. Usually it is advisable in the beginning to have it applied only to the lower extremities; then, later, to the body and the arms. The séance, when the whole body is massaged, should last from forty to sixty minutes. The best time to apply it is in the afternoon or evening. If it excites the patient, makes him restless, sleepless, and discontented, the intensity and duration of the massage must be carefully looked into to see if some modification of it cannot be brought about in lieu of its complete suspension.

The external use of water is even of greater importance than massage as a factor in the rest cure. Any of the various ways of applying water for its tonic effects enumerated in the chapter on hydrotherapy may be utilized. The selection of the procedure will depend entirely upon the patient's capacity for reaction. Water in the shape of hot and cold packs, dripping sheet, prolonged warm baths is used extensively for its sedative effects to combat sleeplessness and manifestations of physical and mental erethism, occurring with the diseases in which the rest cure is appropriately employed. Electricity in the shape of general faradization and galvanization of individual muscles and groups of muscles is not so frequently employed as a component of the rest cure as it was formerly, although it does not deserve to be neglected. It fulfils to a degree the same indications as massage and in addition makes a stronger impression upon the mind of the patient.

As isolation is always imposed, the patient is thus left to the constant and exclusive companionship of the nurse. The selection of this individual is therefore a matter of the greatest importance. Here again we

encounter the difficult subject of individualization, so that it is impossible to lay down rigid rules for guidance in every case. The safest guide is the observation of the effect which the nurse has upon the patient. It is often necessary to change nurses simply because of unreasonable prejudice on the part of the patient. As a general rule it is safe to say that, capacity in the ordinary sense of the word being included, that nurse is best fitted to deal with nervous patients who possesses the greatest amount of what is called reserve force; that is, the one who is most sure of the power to manage the patient and least anxious to display it. Add to this quality a fair amount of intelligence, a much greater amount of tact and endurance, a persistently optimistic disposition and bearing, and an abiding faith in the physician in attendance, and we have the ideal nurse for the rest cure. Sympathy in the common sense of the word, particularly of the emotional variety, has been much overrated. In truth, it is rather to be provided against than cultivated in dealing with such patients.

The administration of medicines with the rest cure depends upon the symptomatic and constitutional indications. To bring the rest cure to a successful issue one must have constantly in mind that it is the combined use of all the measures that have been spoken of and not the one or the other that is necessary.

The plan of treatment is of greatest importance.

The two following schedules, one for the full rest cure as given by Dr. J. K. Mitchell, and the other for the partial rest cure as given by Dr. Weir Mitchell, may be taken to indicate approximately the disposition of time and the utilization of the various measures.

Schedule for Full Rest Cure.

7 A.M. Cacao, followed by a cool sponge bath, with a rough rub and the toilet for the day.

8 A.M. Breakfast, with milk. Rest an hour after.

10 A.M. Eight ounces of peptonized milk, or its equivalent.

11 A.M. Massage.

12 M. Eight ounces of milk or soup, after which the patient can be read to by the nurse.

1:30 P.M. Dinner, followed by rest for an hour.

3:30 P.M. Eight ounces of milk, and a half-hour later the application of electricity.

6:30 P.M. Supper, with milk, followed by rest for an hour, after which the patient may be read to for a half-hour or longer if it does not fatigue her.

8:30 P.M. Administration of malt extract, with aperient if necessary, or the utilization of some measures to induce sleep, such as the drip-sheet or the administration of hypnotics.

SCHEDULE FOR PARTIAL REST TREATMENT.

A.M. On waking, a cup of cacao. Take bath. Specified temperature. Lie down on lounge while using drying towels; or, better, be sponged and dried by an attendant. In this process, the surface is to be rubbed red, or, in drying one's self, use flesh-brush. Bed or lounge again. Breakfast. Before each meal take three ounces of malt extract; aperient at need in malt. Tonic after each meal. Detail as to breakfast diet. If eyes are good, may then read seated in bed. At 10 to 11 A.M., one hour's massage. Rest one hour, may be read to, or if eyes are good, knit. At this time, 11 A.M., four ounces of beef soup or eight ounces of milk. At noon may rise, dress slowly, resting once or twice a few minutes while dressing, and remain up until 3 P.M. See children; attend to household business; see one visitor, if desirable. 1 to 1:30 P.M., malt, etc., and lunch. Detail as to diet. At first, as a rule, let this meal represent dinner. Tonic, and after it to rest on a lounge, occupied as above, reading or being read to. If possible, drive out or use tramway, so as to get air. Walk as little as possible. On returning from drive repeat milk or soup. About 5 P.M. electricity, if used at all. Rest until seven. Supper at 7 P.M. Detail as to meal. Malt as before, with or without aperient, as occasion demands. Tonic. To spend evening with the family, as usual. Best not to use eyes at night for near view. Bed at 10 P.M. No letters to be written for two months, when most of these details have to be revised.

The Art of Relaxation.—Aside from the radical application of the rest cure in certain diseases, the wonderful power of simple relaxation is yet very far from being understood or appreciated, not only relaxation of the body but relaxation of the mind is meant. As a people we are so accustomed to being spoken of as restless and nervous that we have come to look upon the imputation with national pride instead of regarding it as one of our most serious weaknesses. If there is one thing more than another that prevents us from securing adequate relaxation it is multiplicity of interests, many of them unnecessary, and social dissipation. Excessive absorption in vocation is a close second. By multiplicity of interests is not meant business interests exclusively. It embraces family, esthetic, spiritual, social, intellectual, and political interests, which every one has, or should have, and should indulge in proper proportion. An excess of time devoted to some one or all of these robs from that which might profitably be given to the pursuit of some hobby that brings relaxation which every man and woman ought to have. The American habit of intemperate newspaper reading, newspapers with their weird and never-ending details of crime, their pages of foolish social gossip, their columns of made-to-order stories, and their æsthetic-warping pictures

fosters mental atony and dissipates time that might otherwise be profitably employed in securing rest and relaxation. The same may be said of desultory reading, or better said, wading through the tomes of so-called literature that one feels compelled to read in order to find real entertainment and self-oblivion as well as self-improvement. Judiciously limited newspaper and "general" reading will do much toward finding the time for relaxation which every one needs and which so few properly secure.

Excessive absorption in vocation is really the bane of the American business man's life and to a lesser degree of the politician's life. As a nation we are yet too young to have learned to provide adequately for the social side of our nature. We are yet apt to go to one or the other extreme; to espouse the primitiveness and barrenness which characterized the social intercourse of a New England town a generation or two ago—an element of the environment largely responsible for that important factor in many neuroses and psychoses, the New England conscience—or we allow ourselves to be sucked up into the vortex of social dissipation until it proves a veritable Juggernaut to health. It may be advantageous at times to be as aloof as the Mikado or as retiring as a hermit, but, as a general rule, it may be said that temperate indulgence of one's social side is one of the surest preventives of dying in harness, and the most natural way of securing relaxation.

Growth and repair bear a direct relation to physiological rest, local and general. It is essential for every normal healthy life that exercise and rest be properly alternated, the time devoted to the latter being that which nature takes to repair the loss to those powers that are exhausted, and to restore vigor to the body and mind. If the human machinery has to bear too much strain or the time and facilities for repair are inadequate, its work will be done slightingly and it will be only a question of time when there will be perceptible diminution of power and imperfections in the machine. Nor does the want of rest in the ordinary sense of the word cover the whole ground of this deficiency. The need which is meant to be implied is better expressed by relaxation which is the result of change in one's occupation or mode of life, and that which will give complete rest to those faculties that have become fatigued from accustomed use, by giving exercise to others which are usually held in reserve. This explains why physical exercise is often more restful to a man who is overtaxed by mental work than idleness. The principle of relaxation is the same. When all the faculties are suffered to undergo a strain, either from overexertion or from want of proper nourishment, it is evident that general rest is necessary.

Occupation a Therapeutic Agency.—Occupation as a therapeutic agent has not received the consideration that it deserves. Many patients with mild hypochondria, neurasthenia, hysteria, and melancholia obtain more immediate comfort and permanent benefit from participation in properly

selected manual labor than from any other treatment. The mental element is prominent in all these cases and many of the patients date their infirmities from periods of enforced idleness due to lack of opportunity, inability to take the initiative, or to conviction that occupation is injurious. The therapeutic value of engrossing mental occupation in some neuroses is referred to in the chapter on psychotherapy, while the necessity of fitting occupation for epileptics is spoken of in the chapter on epilepsy.

Some opposition must naturally be expected when a mode of life so radically different and perhaps theoretically repugnant as manual labor is proposed, but this can easily be overcome, especially after a short trial when the benefits of it begin to be manifest. Some of the employments that the neuropath may avail himself of are farming, gardening, forestry, carpentry, modelling, and carving. There is much to be said in favor of active life on a farm for city-bred individuals. It takes the patient away from the scenes of his misfortunes and suffering; his lack of mental energy is commensurate with much of the work to be done; and association with the stolidity and reticence as well as the energy and fortitude of men and women which such environment engenders is inimical to self-concernment and exploitation of small ailments. That the patient should not have to conform to the dietary of the average farmer goes without saying. He should participate in the benefits of farm life without the hardships.

If the patient can be got to take an interest in forestry or gardening, these are occupations that can be indulged in to much advantage, as they make strong appeal to the mental, physical, and æsthetic spheres. The advantages of carpentry, modelling, and carving are that the results are immediate and the products sometimes useful. The buoyant satisfaction of doing successful work after repeated efforts have resulted in failure may prove the bit of leaven that the despairing mind needs. To indulge in these requires comparatively slight space and expense, while the muscles brought into action are often those that stand in greatest need of development, such as those of the thorax and abdomen. Moreover, these occupations make the patient much less susceptible to sounds and noises, while they cause a mild degree of fatigue contributory to sleep. Those who have been surrounded with luxuries and indulgent in extravagances soon find that such occupation offers a refreshing wholesomeness in marked contrast with their previous modes of life. For the mentally overworked and those harassed and burdened by affairs and cares it not only facilitates restoration of nutrition and strength, but it is opposed to irregularities in eating and sleeping, and the excessive use of alcoholics and tobacco.

CHAPTER VI.

DIET.

The functional and organic diseases of the nervous system are often caused by or associated with profound disturbance of nutrition. Especially is this true of certain diseases such as neurasthenia, hysteria, epilepsy, and the acute psychoses. In the treatment of many of these neuroses the value of medicine is not to be compared with that of proper diet and the use of physical measures of reconstruction. Therefore it would seem to follow naturally that among the measures for overcoming this disorder of nutrition the selection of appropriate food and its administration in adequate quantities, in short, the principles of modern dietetics, would be of first importance. It is a fact, however, that no subject in the practical application of our art is more neglected. One of the consequences of this is that patients themselves do not place the reliance upon dietary in the cure of their disease that they do upon many other measures which we know are of comparative insignificance.

Adequate and appropriate nutriment does not, of course, always mean a larger quantity than is ordinarily taken. On the contrary, in many instances, such as in neurasthenia or migraine dependent upon or associated with the uric-acid diathesis, it may be of signal importance to diminish the quantity of food and to eliminate largely certain kinds, such as the red meats. It may, however, be stated as a general rule that the neuroses are more frequently the result of insufficient and inappropriate food than of overfeeding.

The proper nourishment for a particular case must consider not only the quality and quantity of food, but the frequency and regularity of feeding, the amount to be taken at one time, and likewise the adaptability of the diet to the needs and peculiarities of the individual. For this reason it would be manifestly impossible to give rules which would apply to patients with the different forms of nervous disease. It is particularly in cases in which auto-intoxication plays an important rôle, either in the causation or maintenance of the disease such as in epilepsy, that rules of this kind might apply in more or less routine fashion. An effort will be made to consider this aspect of the subject in the chapters devoted to the treatment of the individual diseases.

The object of food in disease is the maintenance of vitality and the re-establishment of nutrition, and thereby the restoration of tone to the

various systems of the body that they may resume their customary functions. The diet that will best meet these requirements is the diet best suited to each case. In other words, there is no food known which has special properties to nourish the nervous system. For a long time there was a popular belief that fatty foods possessed such virtue, and it is yet generally believed by the laity, and by some members of the profession as well, that fats and substances which contain a conspicuous amount of phosphorus, such as some of the cereals, have peculiar beneficial properties in exhausted states of the nervous system. It is generally conceded, however, by physiological chemists, that this is not so. Fats are force producers because of the oxidation which is necessary for their disposal, but they do not, because of this, have signal effect upon the nutrition. All that can be expected of any food is that it shall contribute to general nutrition.

Whatever may be said of the relative importance of the proteids, animal or vegetable, or of the hydrocarbons, a mixed diet is the only one that meets all the requirements for the maintenance of health. It may be stated as a general rule that a slight preponderance of the nitrogenous foods is most appropriate for persons of the neuropathic diathesis. It is estimated that the amount of carbon and nitrogen required by the normal person is in the ratio of 16 to 1, it matters not what his politics may be. Therefore, an exclusively meat diet would provide far too great an amount of nitrogen for the carbon that it would bring into the system, while on the other hand the starches, in order to supply sufficient nitrogen, would give twice as much carbon as the system requires. This is one of the fatal mistakes of an exclusively vegetable diet. Several times the amount of starch must be taken that the requisite amount of nitrogen be obtained, and naturally the system rebels against this abuse (as it does against most others).

Milk is the most nearly perfect of all foods, as it contains the necessary substances, proteids, fats, starches, water, and inorganic salts in a proportion approximating that which the system requires. It is practically the only substance upon which a person can maintain perfect health for a long time. A serious objection to milk as a sole article of diet is that it contains too large a proportion of nitrogen to carbon to constitute the exclusive diet for a person in health. In disease, however, it may be just the food that is needed, particularly if the oxidizing capacities of the patient need stimulating.

Milk or some preparation of it should enter largely into the dietary of nervous patients. An exclusive milk diet for a time is often necessary in the treatment of certain diseases such as epilepsy and neurasthenia. It is an important element of the rest cure, and in many diathetic conditions the greatest reliance is placed upon it to influence the disease if the patient is able and can be induced to take it. There are various methods

of preparing milk for patients in whom it causes unpleasant effects when taken in the raw state. Skimming and boiling make it more digestible, and diluting it with plain or aerated alkaline water often overcomes any tendency which it may have to produce pyrosis, dizziness, constipation, etc. When it tends to cause those symptoms commonly called "biliousness" they can often be prevented by the addition of small amounts of common salt, bicarbonate of soda, phosphate of soda, or milk of magnesia. If despite such modification or addition milk cannot be taken without disagreeable results attempt should then be made to give it in the form of partially digested or fermented milk, such as peptonized and pancreatinized milk, whey, kumyss, matzoon or zoolak. Many patients who cannot tolerate milk in a natural state or modified in any of the ways mentioned are able to take it in combination with other substances such as rice, wheatena, shredded wheat, cocoa, and fruit. Others can take it in considerable quantities if mixed with a small amount of tea or coffee.

Water is a very necessary part of the diet of neuropaths, although unfortunately it is not partaken of by the vast majority of people in sufficient quantities. Many persons go for weeks and months without taking water excepting as it is contained in their food and such drinks as tea and coffee. This is especially true of women who, from fear of becoming fat or from lack of thirst, due to insufficient exercise, rarely take water in its natural state. It is not improbable that this is one of the causes of constipation common in women, and which physicians know to be responsible for many of the minor ailments of women. Water should be taken in small quantities, not more than four to six ounces, at meal-times, and as freely as desired between meals, unless there is a tendency toward obesity when the amount which the person can consume must be curtailed, unless he or she is willing to take active exercise. The taking of a glass of water just before retiring, and immediately on arising, unless it is the custom to breakfast at once, should be encouraged. Oftentimes the alkaline waters may be used to better advantage than plain waters, particularly as they are taken with more relish and therefore in larger quantities. The carbonated waters should be used with caution as they may induce flatulence and distention of the stomach attended with distressing symptoms. In special conditions, such as the uric-acid and rheumatic diathesis, in the treatment of many diseases such as neuralgia, neurasthenia, and tabes, and in combating certain tendencies such as obesity and anæmia, the mineral waters are of much service. The mineral water that one elects to administer will depend entirely upon the condition that it is desired to overcome. In the uric-acid diathesis the Vichy water of France, as well as the native and artificial Vichies, are often of great service; while in the treatment of anæmia there are many chalybeate waters that are far more serviceable than the administration of an equal amount of iron in any other form. The great advantage that the waters have as a vehicle

for a medicinal substance is that they stimulate the emunctories of the body to renewed activity, which in itself is very beneficial.

In regard to the particular value of the different classes of foodstuffs, the fats and starches are the most important as heat producers, and the proteids as flesh producers and tissue builders. It should not be forgotten that the animal fats and the animal proteids are more easily digested than the vegetable fats and the vegetable proteids. An important feature of the vegetable foods, however, is that they contain, besides the elements that are essential as heat producers and flesh producers, mineral constituents, such as sulphur, phosphorus, sodium, potassium, and the like, which are essential to the economy, and a very large proportion of water. The vegetables that grow above the ground, peas, beans, and lentils, and the edible fungi, are the most important substitutes for meat. Mushrooms, however, are not, as has frequently been asserted, a substitute for meat and should not, be the principal part of the meal. In the small amount of proteid they contain they resemble rather the fruits such as apples, pears, peaches, and melons, and consequently cannot take the place of a concentrated food. Fruits are not very nutritious, but they are important constituents of the dietary because of the water and the vegetable acids that they contain. The latter have a most salutary effect upon the system, and in some hæmic diseases are strictly curative. The laxative effects which most fruits have is also advantageous to nervous patients.

When determining the kinds of food and the amount which are indicated in any special case, it should always be kept in mind that the animal foods are the most nourishing and should constitute a conspicuous part of the diet of persons who are making demands upon their vital forces. This is especially true of anæmic patients and those who are run down from overwork or exhausting experiences. These substances, including milk, eggs, meat, fish, gelatin, and fats, contain the nutriment in a concentrated form and in approximately the same chemical combination as the body. Meats, especially red meats, are frequently taken too often and in too large quantities, especially by those who have the uric-acid or rheumatic diathesis. It is often advisable to limit their consumption to once a day, and to supply their place by fish, white meats, and vegetables rich in proteids. The best meats for the average nervous person are fowl, beef, mutton, and pork, the latter preferably in the form of bacon. The remainder of the diet should consist largely of milk, vegetables, and fats, the latter taken in the shape of olive oil and cream. Vegetable fats should be taken, particularly by thin, anæmic patients, in as large quantities as can be consumed without disturbing digestion. If the digestive capacities are not much impaired, the animal fats should likewise be administered. Of the vegetables, those which are coarse and green are of especial value, particularly if a tendency to constipation exists. As to the matter of beverages and drinks, coffee, tea, and cacao, if taken in moderation, are

usually harmless to the adult, but they should never be given to children of the neuropathic diathesis. Neither should they be taken with sugar by those who have the uric-acid or rheumatic diathesis. Alcohol is just as much a food as any of the substances composed of the elements. The drawbacks to it as a food are that it contains these elements in too great concentration, or without bulk as it were, and the great liability to its excessive use. Neither of these concerns us here. Alcohol as an article of diet is best taken in the shape of light wines and unadulterated whiskey. Comparatively few persons after middle life can take malt liquors advantageously. The numerous malt extracts now upon the market, and reputed to be of great service as agencies of reconstruction, deserve very little support from the physician. They possess no peculiar properties that can be utilized to advantage. If the patient has been in the habit of using alcohol as a beverage or otherwise, he may be permitted to continue its use in strict moderation, particularly if it assists digestion and promotes absorption, as it not infrequently does. It will often be necessary, however, to insist that the patient reduce the amount of alcohol consumed, for, unless taken at meal-time and well diluted, it is an easy matter to overdo. When the disease has any causal relationship to alcohol, or when the phenomena of the disease seem to be exaggerated by the taking of alcohol, then alcohol should be absolutely interdicted. To this rule there are few exceptions. The only one worth mentioning is the treatment of delirium tremens, in which it is sometimes necessary to keep up for a time a degree of alcoholic stimulation.

The time when food should be taken is an important matter for the individual suffering from nervous disease to consider. Although regularity in eating is very desirable, such a person should take food whenever there is real inclination for it. Neurasthenics particularly are often benefited both temporarily and permanently by taking small quantities of easily digested food when they have what they call sinking feelings. Whether or not food should be taken at bedtime depends upon the individual and upon the interval between the evening meal and the hour of retirement. Most persons of the neuropathic constitution, as well as most sufferers from nervous disease, are usually benefited by taking a small quantity of some simple food, such as a glass of milk and a biscuit, on retiring, particularly if more than two hours have elapsed since the last meal. Of quite as much importance as the quantity and quality of the food in the treatment of some nervous diseases is the method in which it is taken. Neuropathic persons almost invariably eat too rapidly. They often masticate sufficiently, but the sum total is put into the stomach in too short a time. On the other hand, epileptics are notorious for bolting their food and for eating ravenously. The viciousness of such custom need scarcely be pointed out.

There are few dietary fashions that are more pernicious to the neu-

ropath than the order of the modern dinner. Usually those substances which are not digested in the stomach, starches and sweets, are put in at the end of the dinner, constituting oftentimes more than two courses. They are retained in the stomach for a protracted time, and starchy fermentation with its entailment is the result. It is still the custom of many to eat fruit at the end of a full meal and for the individual with unimpaired digestive capacity it may be quite innocuous. It may, however, be looked upon as an evidence of progress in civilization to begin, rather than end the meal with fruit.

The question will also arise, Should food be given between meals, and if so, what kind and how much? Here the physician must exercise care and judgment. As a general rule the interval of time that should elapse between meals or before the further ingestion of any food is three and a half hours. This, however, will vary with the kind and quantity of food. In low states of the nervous system it is usually necessary to supply the system with nourishment at frequent intervals. It is in this matter that many physicians are in error. Milk, the food most generally given in such cases, requires fully two hours for its digestion and therefore must not be given at shorter intervals, or the formation of proteose and of peptone will be withheld. Far preferable is it to give a larger quantity at one time, keeping always in mind that the average capacity of the human adult stomach is two litres.

Brief reference must be made to artificially prepared and concentrated foods. Healthy individuals living under normal and customary conditions should avoid them. There is a tendency at the present time to feed mankind with substances of very slight bulk which may be taken without expenditure of time or energy. From an economic standpoint this may be all right, but I am convinced that from a dietary standpoint it is all wrong. The various nut foods and artificially treated cereals which are now on the market in great abundance fall far short of meeting the requirements of an adequate diet, even though their capacity to produce energy and their constituents may be attested by ever so many chemists.

The artificially prepared or partially digested foods should never be taken by persons in health, as such indulgence tends to create disorder of the digestive and assimilative functions, in the same way as every function becomes perverted when it lacks suitable initiation and stimulation. Even during disease they should not be used continuously or, save in rare instances, to the complete exclusion of other foods. As a rule, the patient who can digest any of the different beef extracts can digest the juice expressed from raw or slightly cooked beef. It is a very common mistake in certain nervous diseases associated with digestive disorder to give too large a part of the food in the form of liquids and predigested preparations. The result is to weaken the stomach and thus increase the disorder by giving that organ too little to do.

Of almost if not quite as much importance as the kind of food is the quantity that can be taken with advantage. In few nervous diseases is it necessary to place rigid restrictions upon the quantity of food to be taken. Save obese neurasthenics, nervous patients are likely to eat far too little. Usually their digestive and assimilative capacities are impaired. For this reason such patients must be fed at frequent intervals, almost all of them requiring food at least five times in the twenty-four hours.

Not infrequently the error is made of laying too much stress upon the diet of nervous patients. Particularly is this true in cases of neurasthenia accompanied by considerable mental depression, morbid fears, and anxieties. Detailed attention to what they shall eat tends to anchor the mind to their infirmities and to exaggerate the importance of them. In such cases, providing there be no considerable disturbance of either stomachic or intestinal digestion, recovery is facilitated by diverting the patient's mind from contemplation of his symptoms, of which slight dyspepsia is often a conspicuous one; and this can sometimes be done more efficaciously by letting the patient eat what he will, providing that he eats enough.

As has been said, the regulation of the diet will depend largely upon the individual and the various factors which contribute to his infirmity. Experience teaches that not the least important of these complications is the effect of the mind on the different functions of the body, the digestive organs not excepted. It is by no means uncommon to see persons suffering from some comparatively slight nervous disorder attended by inconsequential disturbance of digestion, put upon such restricted diet that as a result they undergo a process of slow starvation. This of itself offers the greatest obstacle to recovery, while it augments the symptoms, even apart from the morbid condition of the mind which is an invariable accompaniment. The thing to be kept in mind in the dietary treatment of nervous diseases, as in the utilization of every kind of treatment, is the interdependence of mind and body; the wonderful, inexplicable influence of the one upon the other. And the object should be the simultaneous treatment of both.

CHAPTER VII.

PSYCHOTHERAPY.

PSYCHOTHERAPY owes its position of chief importance among the general therapeutic agencies in the treatment of the diseases of the nervous system to the advances of physiological psychology, the exploitation of the phenomena of hypnotism, and the better comprehension on the part of the physician of the influence which he is able to exert upon the minds of his patients, and through that upon their bodily processes. A consistent treatise on the treatment of nervous disease must of necessity enter with some degree of fulness and detail upon a consideration of those influences which affect directly the patient's mental condition and attitude. These psychical influences or stimuli may form a part either of the natural environment of the patient or the artificial environment prescribed by the physician.

Much of the mystery surrounding the response of the body to mental stimuli has been done away with. Although we are far from being able to give a satisfactory scientific explanation of the manner in which mental stimuli exert through the cerebral cortex their effects upon the rest of the nervous system and upon the entire body, yet these effects have been definitely ascertained and the physician can now avail himself of such stimuli with the confident expectation that the results which he desires and anticipates will be attained with some measure of fulfilment.

The mere affirmation of the close relationship between the body and the mind is trite indeed. Every physician is well aware that disordered digestion, functional inactivity of the liver, or deficient excretion through any of the emunctories will produce states of mental depression. He is even assured that some definite form of mental emotion may accompany specific bodily disorder, as for example the euphoria in terminal stages of pulmonary tuberculosis, the pessimism attending even the early stages of disease of the liver, and the depression attending organic diseases of the intestine. The physician is in general sufficiently acquainted with the influence of mental conditions on bodily processes, whether or not these form part of the symptom complex of a disease. Such are the disturbance and retardation of digestion produced by anxiety and fear; the secretion and voiding of large quantities of urine, and the occurrence of diarrhœa as the result of intense joyful or depressed emotions.

That the significance of this reciprocal interaction of body and mind is far from being understood and given the consideration that it demands

of the practising physician and neurological specialist, is well attested by many facts. One illustration will suffice to make this clear. It is customary for many physicians to speak of a pain or of other symptoms as being sometimes "imaginary." Frequently a "mental" pain is spoken of, or it is referred to as hysterical. What the physician intends to suggest by the use of these terms is the absence of a discoverable cause of the symptoms. An hysterical patient may have pain localized, say, in the shoulder, which is increased by physical exercise, causing distress of body and mind. Still, it is absolutely demonstrable that there is no organic or functional conditions of the shoulder to account for it. Such pain is as real as if it were the resultant of ordinary physical causes and should arouse our best efforts for its relief. The inappropriate designation too frequently implies that there is also no physical basis whatever anywhere in the body. The only purely imaginary symptom without physical basis is one that a patient describes when he is not telling the truth. If a patient thinks he has a symptom and describes it in such a way that one is compelled to believe that he possesses it as a mental content, there is at least in the processes of the cerebral cortex some definite physical basis and location. That such basis may not be known nor its location assignable matters not. It can be accepted without any reservation whatsoever that there is no mental content, whether it be an idea, a thought, reason, memory, sensation, or volition, without an underlying physiological process connected with the cellular entities of the cortex of the cerebral hemisphere. The capacity to produce modifications or symptoms elsewhere in the nervous system or in even remote portions of the body will depend entirely upon the capacity of the portion of the cerebral cortex involved to produce, through its anatomical and physiological connections modifications in other associated tissues.

Recent physiological and psychological investigations tend to emphasize the unitary aspect of the entire organism. That is to say, every stimulus, no matter what its point of origination, such for example as a sensory stimulus directed to one of the special sense organs or applied anywhere to the surface of the body, or an intracorporeal stimulus applied to the spinal cord or to any part of the cerebral cortex, will tend to be deflected or spread out through the entire organism, as a wave diffuses itself over the surface of water when a stone is dropped into it. Some tissues, owing to closer physiological or anatomical connections with the cerebral cortex, will be more affected than others. Special investigation alone can determine just what the direct channels of diffuse stimulation may be. Inasmuch as physiological process may modify structure, in other words, functional use and disuse may produce organic modifications, there may be expected to be peculiarly favoring conditions of excitation of the cerebral cortex that will effect not only physiological processes in remote portions of the body, but determine as well permanent

organic changes. The cortical excitation, no matter how it may be awakened, even though its most definite manifestation be only an idea or an emotion, may therefore be assumed to be capable of producing both functional and organic disease of the nervous system, and in less degree of all other tissues of the body. It is not my purpose to give even a summary of results of recent investigations pointing to the influence of mental conditions and their associated cortical processes upon functional and structural modifications throughout the organism. It is proposed merely to call to mind certain facts of almost common knowledge that will indicate the possibility of such interrelation.

The most common manifestation of mental influence upon the body is that which is found to be exerted upon the voluntary muscular system. Indeed, so common is this that its significance is often overlooked. If it is wished to produce the complex co-ordinations necessary in picking up a stone and throwing it at a mark, the only practical way of causing this bodily action is to point to the stone and the mark, and to tell the person what is desired of him. A common description, though it is not an explanation of the result, is that the subject wills the action which he performs. The act of willing a volition takes place only under certain definite conditions. He must see the stone and the mark and hear the words; that is, the sensory stimuli must act upon his cerebral cortex and there awaken processes which give rise to certain definite ideas. One of the most important ideas involved in the process of volition is the idea of the movement or the kinæsthetic memory idea of the contraction of the muscles. Volition seems to resolve itself primarily into an act of exclusive attention; that is to say, an exclusive consciousness of the idea of the movement to be performed or of some idea closely associated with it. When the idea of the movement is presented vividly in consciousness to the exclusion of other ideas that may be contradictory to or inhibitory of it, the movement will of necessity follow. This kind of activity has been called ideo-motor action, a term that emphasizes the essential, instantaneous, and almost automatic sequence of the movement thought of upon the idea of the movement. If the idea of the movement can be intensified, or if contradictory and inhibitory movements can be excluded to a greater degree than normal, a movement of more considerable intensity may result. This is well shown when we give a man a dynamometer and ask him to squeeze it as hard as possible, and then follow with certain encouraging words which cause the second trial to be considerably more effective than the first. Different persons will be acted upon by the same stimulus in different ways. A source of great danger, such as a fire, may bring out powers of motor activity in one man, and reduce another to a state of hopeless inefficiency. All training, whether it be for physical effort as in a footrace, or for intellectual effort as in a struggle for professional existence, will resolve itself into a strife for

complete ascendancy of ideas fittest to produce activities over others that are less fit and perhaps negatory. The complexer co-ordinations of the human being can be brought about only by this ideo-motor activity of the consciousness. For that reason their manifestation in connection with any organism is taken to indicate the presence of some consciousness. Neither electrical stimulation of muscles, nerves, or brain centres, nor pathological excitation of the cortex, is capable of producing the persistent and complex co-ordinations of every-day life.

That this influence of ideas upon the muscles is not merely the manifestation of some mysterious power of volition, is evidenced by the fact that it extends also to the involuntary muscular system. A dangerous object arousing fear, or even a thought awakening the emotion of fear, may cause relaxation of the sphincters. It will produce disturbance of respiration and modify the heart-beat. An idea of some nauseating substance will stimulate involuntary contractions of the muscles of the gullet and diaphragm and may even lead to the act of vomiting itself. The vascular system shows its affectability by the blush of shame, the flush of anger, and the pallor of fright. The secretory system responds with a watering of the mouth on the thought of a savory tidbit, with the profuse perspiration that attends the realization of great danger, or with the prostatic and seminal secretions that follow natural sexual stimulation or even lascivious thoughts.

The readiness of bodily actions to follow upon mental conditions varies greatly in different subjects. In all some measure of response to these mental incitements will be manifest, and in many the reaction may be considerably exaggerated by an appropriate conjunction of circumstances. Those aids to the exaggeration of the normal response of peripheral process to such mental stimulation have been rather crudely summarized under the caption of Suggestion. It is well to distinguish the intentional or accidental employment of stimulating thoughts, sensations, and emotions, from the implantation in the mind of the patient of some definite or indefinite idea which it is expected will be followed by remedial consequences directly relating to the idea thus implanted. A cheery bedside manner or a consistent position of stalwart encouragement may act directly upon the patient to develop a mental well-being which of itself has a beneficial effect upon the physical organism. It is not the cheerfulness that is the essential factor, for its place may be taken by austerity, by eccentricity, by systematic brow-beating, and these are sometimes employed purposely or naturally by the physician as a part of the "bedside" manner. The natural or assumed manner of the physician may thus arouse in the patient feelings and ideas which we have shown to be capable of bringing about changes in the different systems of the body, particularly the vegetative system, that contribute to the restoration of the equilibrium of nutrition. The mere presence and manner of the physi-

cian do not act otherwise than would other factors predisposing the patient to favoring mental attitudes. Other stimuli of the environment act in the same way and may be oftentimes profitably employed. Thus, music or devotion to any art, physical exercise, mental work, preoccupation in a favorable love affair, may all alike condition remedial states of consciousness. The physician should not consider himself above using these normal aids to the restoration of health. If they have no other influence upon the patient, they at least divert him from introspection and possible hypochondria.

Upon the other hand, the physician's bearing and words may give the patient a direct suggestion in the direction of physical well-being. This suggestion may be either a general one, as when he inspires the patient with confidence in his ability and with the thought of speedy cure, or it may be specific, as when he gives stimulating counsel, definitely related to the amelioration of particular symptoms and sturdy persistent encouragement based on exhaustive physical examinations and consistent reasoning. The employment of specific suggestion is more frequently called for in nervous diseases, particularly in neurasthenia, hysteria, and "habit diseases," than in the treatment of other diseases.

In many functional diseases, such as neurasthenia and hysteria, it is often necessary to make the suggestions in a very forcible way; the patient may be informed that he will show marked signs of improvement within a certain number of days, or he may be threatened that if he does not improve he will be sent away or placed in the hospital. Casual suggestions are often more effective than intentional ones. An apparently unstudied remark to the nurse or a bystander that the patient shows signs of improvement will often bring about a desired bettering of the patient's condition, or the patient may be permitted to overhear a conversation addressed to members of the family. The physician may have to indulge or cajole, he may need to threaten or to promise, and all of these agencies, although they may have little effect upon the patient's disease, will yet at least cause him to take the prescribed drugs regularly, to submit to physical treatment, or to follow a strict regimen in diet.

The same methods will not be effective with all persons. It is often more necessary to treat the patient than to treat the disease. To be all things to all men is as much demanded of the physician as it is of the coquette thirsting for extensive conquest. It will be necessary and desirable to take into consideration the patient's temperament, his manner of life, his culture, his social scale, his personal and family history, his specific beliefs, his likes and dislikes. If he is religious, prayer may help; if superstitious, a horse chestnut, an image of a saint, an amulet, or any fetich. Each physician will have to judge for himself how far he is willing to come down to the belief and principles of those whom he is treating. It will be fortunate for both him and his patient if the latter

is not bereft of all credence and susceptibility to ready acceptation of what is stated with an air of authority and conviction. The most recalcitrant sufferer from nervous disorder is the patient who has lost his childlike faith in the religious beliefs of his father, and who has led a worldly life in which ambition and individual force of character have superseded primitive intuitional moral principles and bland acceptance of social ideals, leaving l im without confidence in any person or any action.

It must ever be borne in mind that it is one thing to cure a patient and another to have him stay cured. Auto-suggestion is exceedingly effective in producing disease but seldom works its cure. Through auto-suggestion the neurasthenic or hysteric shows a woeful tendency to backslide into his previous condition. Many of the cures of one physician pass over into the hands of others with all the work to be done over again, but the able first physician keenly recognizes that it is not alone his duty to cure a patient but to leave him better able to be cured again. Suggestions are thus particularly effective when they are new. This applies to all those agencies that depend in part or entirely upon suggestion.

General and specific suggestions are not limited in their applicability and usefulness to the functional diseases of the nervous system alone. Patients suffering from organic disease often show marked improvement as the result of advice which can have no direct physical influence on the malady itself. The general practitioner and neurologist can meet no case in which they are not required to take a position that looks singly to the patient's happiness and comfort. It is for the physician to infuse hope into his patient, promise help, and call attention to the favorable signs which the latter in his despair often fails to see. Even in incurable diseases, it is very seldom the physician's duty in the premises to inform the patient of the absolute hopelessness of his disease. It may be satisfying to the physician's despondent frame of mind to say that the most heroic and orthodox treatment of the organic nervous diseases is often worse than useless. It may be a triumph of conciseness and frankness to terminate a discursive consideration of disseminated insular sclerosis or of Friedreich's disease with the words "all treatment is useless." But the endeavor to force either of these states of mind upon the victim of such disease will result in more serious consequences than a reduction of the physician's clientèle. Ethical obligations compel the physician to prolong his patient's life and to keep him from suffering. To gain these ends the diseases of the nervous system which are generally considered incurable must be treated as carefully and persistently as if there were a reasonable chance of overcoming them. This, it seems to me, is a fundamental principle in the treatment of nervous diseases and one which must be admitted by all who aspire to become successful therapists. When the surgeon encounters a wellnigh hopeless operation he does not forthwith forego all treatment and suggest that the patient only stand

and await death. No more should the neurologist in the presence of a case of bulbar paralysis spare any effort in utilizing measures that have been shown to be of even the slightest benefit or in experimenting with substances that may possibly be found useful. Sometimes it may be necessary to tell the patient that his disease is incurable, but this should be followed by the assurance that it may not materially shorten his life. It is, of course, very dangerous to advise that a physician step beyond the bounds of truth in the statements that he makes to his patients. If he continually informs his patient that his disease is not a serious one and that he is making rapid improvement, it will lessen the patient's confidence in him. It is therefore often better to be frank with the patient, and inform him that his complaint is really serious. It is the appearance of frankness that is more demanded than its actuality, and it should be the physician's first aim to gain the entire confidence and implicit obedience of the patient. It is for these reasons that physical measures are often to be recommended, even when they can have but little therapeutic value. They strengthen the patient's faith in his physician and they constitute a material basis upon which the physician can build his suggestions. For a similar reason, frequent examination of the blood and urine may provide evidences of improved metabolism and be comforting to the patient. The mental effect of the physical agent upon the patient is ample warrant for faith in such therapeutics. This is not intended to imply that all drugs and physical measures have the same therapeutic value. It is incumbent upon the physician to be as skilled and discriminating in the employment of the physical agents as he is tactful in developing a healthful mental tone and responsiveness to treatment. He may learn that he obtains many successes from drugs that are useless. A rabbit's foot and a lively faith in its healing properties are more efficacious than medicaments that are often recommended even to-day.

The history of therapeutics teaches us that many drugs have been employed with large measure of success, whose activity has been ascribed to properties which they have subsequently been found not to possess. It is not necessary for us to deny to sympathetic cures, to homeopathy, osteopathy, to faith cures, Christian Science, to magnetism and metalism, all possibilities of success. When such an authority as Moebius asserts that four-fifths of all electrical cures have been effected in cases wherein electricity could not have been of the slightest avail, it may be seen that the mental factor has a large scope for its influence. Certain physical agents, moreover, such as warm and cold baths, have a direct influence in stimulating the will. The self-respecting physician will have much hesitancy in looking with any favor upon methods which seem in his mind to be associated only with fakedom and quackery; but it rests upon him to distinguish the mental factor from the physical agencies in the measures to which he has recourse. He must develop

sufficient ability and knowledge to distinguish between the remedial though suggestive value of drugs and other physical measures, and the hopeless credulity involved in such procedures as mind cures through thought transference, or the telepathic action of drugs.

Hypnotism.—I have already called attention to the fact that moments of great tension may lift the individual to a stage of supernormality, or at least abnormality. States of exalted emotion, such for example as those so often related in the history of martyrs and saints, and even of religionists who are more apt to be called cranks at the present day, show those subjected to them to be possessed of supernormal capabilities, unusual control over bodily processes, and great susceptibility to suggestion. Hypnosis is a state of exalted suggestibility, capable of artificial production in almost all persons in which the subject affected is more than ordinarily susceptible to the control and stimulation of the one who has thrown him into the hypnotic state. There is no more mysteriousness about it than there is about other modes of beneficent influence that every physician uses in daily practice and which have previously been discussed. It is not my intention to describe the methods of hypnotism nor the details of the phenomena appearing in the state of hypnosis. Suffice it to say that hypnosis is a sleep-like condition in which certain parts of the brain seem to be thrown out of function. This is particularly true of the associational inhibitions that play such an important part in every consciousness in the normal state. The mind is thus bereft of many of its acquired possessions, and attention is focussed to a limited number of processes. The degree to which hypnosis can be produced differs greatly in different persons. Some can be thrown only into light somnambulism, but even this is of assistance to nervous patients, as it puts the subject into a state of calm submissiveness and strict attention. The deeper stages of lethargy and catalepsy are difficult of production and of little or no therapeutic value when produced. Unfortunately, those patients who are not susceptible to ordinary suggestion are generally refractory under hypnotic influence, although a very unsuggestible person may sometimes be thrown into deep hypnosis by mechanical means. The moral effect will be to make him more subservient to the wishes of the physician, and specific suggestions will sometimes then be effective. In general, profound hypnotic susceptibility is an indication of the neuropathic diathesis. It is impossible to give definite rules as to when hypnotism is applicable and when it may be serviceably employed. This must be left to the discretion of the physician, who will need to measure his own powers and to consider the character of his patient. Some physicians will perhaps never need to have recourse to hypnotism; others will employ it with a fair measure of success. In general, hypnotism should not be resorted to unless the indications are that suggestions in the normal state, combined with adequate physical measures, will be totally ineffective.

Hypnotism has been employed successfully, if we may give
reports, in the treatment of youthful perversity, mental and mo
certain partial forms of mental maladies, such as fixed ideas, a
dominating habits, hypochondria and indecision, what may
present be termed hypnotic suggestion is often useful. Alc
morphinism, insomnia, and sexual perversion have also been a
to this mode of treatment. Hysteria and paralytic manifestatio
such as hysterical aphonia, cramps of the involuntary muscles, h
anorexia, stammering, and hysterical disturbances of sensibilit
occasionally to hypnotic suggestion. In mental disorders in the
sense, in epilepsy, chorea, and paralysis agitans, the function of su
is to produce emotional calm, and in this manner it may be of s
even in organic diseases such as tabes and multiple sclerosis. I
hypnotism as a therapeutic entity has a very insignificant positio
therapeutic measures of considerable value and wide application.

PART III.

DISEASES OF THE MENINGES AND THE BRAIN.

CHAPTER I.

THE TREATMENT OF MENINGITIS.

When the unqualified term meningitis is used, inflammation of the pia, or leptomeningitis, is understood. The dura may also be the seat of inflammation, although on account of its predominantly fibrous structure and insignificant vascularity it is much less liable to such disease than the pia. Inflammation of the dura is known as pachymeningitis.

Leptomeningitis.

Leptomeningitis is subdivided into: 1. Infectious or true meningitis; and 2, pseudo-meningitis or meningitis serosa.

Infectious meningitis may be the result of different bacteria, but the vast majority of cases are due to one of the four following: the pneumococcus, the staphylococcus, the diplococcus intracellularis, and the bacillus tuberculosis. Very rarely is it due to streptococci, gonococci, the colon bacillus, or the bacilli of influenza and erysipelas. The pathological product of meningitis excited by one or other of these organisms, is more or less variable, but it always contains pus in greater or lesser quantities. The coexisting serous, fibrinous, and sanious exudate will depend largely upon the microbic nature and intensity of the infection.

Etiologically and clinically, three distinct varieties of true infectious meningitis may be considered. These are: 1. Ordinary purulent meningitis due to infection by either the pneumococcus or the staphylococcus, or to one of the less common bacteria above mentioned; 2. Meningitis due to the diplococcus intracellularis, and known clinically as epidemic cerebrospinal meningitis, or cerebrospinal fever, and 3. Meningitis due to the bacillus tuberculosis, and known as tuberculous meningitis. The etiology and treatment of each of these conditions will be considered separately.

Non-infectious meningitis, meningitis serosa, or pseudo-meningitis is a dropsical condition of the pia, which occurs under two rather distinct auspices: In chronic alcoholics, in which it constitutes the condition

known as wet brain; and in infants and adults as an expression of a diathesis, such as rhachitis and other depraved states, and after injury.

Like every other disease of the serous membranes, leptomeningitis may pass into a more or less chronic condition, but this is always secondary to an acute process, unless the change in the meninges be a degenerative one. The typical form of chronic leptomeningitis is the variety due to syphilis. It is somewhat questionable whether this form of meningitis should be classified among the inflammatory varieties. It is not a true inflammation, unless one admits that the occurrence of exudation constitutes inflammation. Syphilitic infection may produce disease of the meninges in two ways—first, by causing a degeneration of the pia, the morbid conditions being mediated through the vascular supply; and second, by influencing the pia so that it becomes prone to the action of the factors which cause true inflammation.

Etiology.—The causation of meningitis may be considered under two heads: 1. The conditions which precede the attack with such frequency that they may be properly considered predisposing causes; and 2. The exciting causes. As the latter are now known to be certain varieties of bacteria, mere enumeration of them is sufficient, but somewhat extended consideration of the predisposing causes seems necessary.

The predisposing causes are a variable quantity in each case.

Leptomeningitis is more common in early adult life than at either extreme, despite the fact that there is an infectious meningitis of the newborn. It occurs more often in males than in females, the predilection of the former being due to their greater liability to excesses and experiences, such as alcohol and injuries, which are contributory factors to the disease. Leptomeningitis is more common in every form, so-called idiopathic, sporadic, or epidemic, in the spring and winter, not alone because of certain climatic conditions which exist at these times that are favorable to bacterial development, but because the infectious diseases occur more commonly during these seasons. Of the habits to which mankind is addicted, the most potent in producing meningitis is excessive indulgence in alcohol. This is easily understood when it is kept in mind that a disordered condition of the circulation of the brain and pia is a physiological effect of alcohol.

All the conditions that predispose to acute inflammatory diseases, such as exposure to wet and cold, particularly if the vitality of the patient is in a lowered state from overwork; worry and anxiety; previous disease; prolonged and exhausting application of the mind; exposure to extremes of temperature or to the direct rays of the sun; atmospheres that are noxious and enervating; slight and repeated injury of the head; and the coexistence of bodily disease predispose to meningitis. Some writers believe that neuropathic constitution predisposes to meningitis, but it does not seem to the writer that there are adequate reasons for

such a view. In a certain number of cases of meningitis, the most diligent search fails to reveal any causation save trauma, which may have been so insignificant that one is loath to attach serious import to it. The trauma acts, in all probability, in so depreciating the vitality or resistance of the meninges that the actively exciting cause may become operative. A much larger number of cases, but still small when compared with the entire group, are those that follow severe injury to the head, injury that not only wounds the epicranial coverings but the skull as well. Meningitis developing after a surgical operation is, in these days of aseptic surgery, comparatively rare. The wounds that are most apt to become complicated with meningitis are the penetrating and crushing wounds; the first because they clear the way to the meninges, and this facilitates the work of infection carriers; and, second, because of the resistance that they offer to cleanliness. Penetrating wounds of the eyeball, with or without cyclitis, are very prone to excite meningitis.

One of the most important factors in the causation of infectious meningitis is the extension of inflammation from pyogenic disease of adjacent structures and cavities, such as the mastoid process and middle ear, the cavities of the nose and antrum of Highmore, the sphenoidal and ethmoidal sinuses, and the sinuses of the frontal bone, the cells of the ethmoid and the sphenoidal fossa, septic disease of the orbit or its contents, cranial osteomyelitis, and septic diseases of the epicranium and surrounding soft tissues. Of the latter may be mentioned in the order of their importance, erysipelatous inflammation of the deeply seated structures at the junction of the jaws, the skull and the neck; anthrax, carbuncle, furuncle, suppurative parotiditis, septic tonsillitis, angina Ludovici, and, in short, all conditions excited in the soft or hard parts by specific bacteria. Of the causes included in the second category, those attributable to the mastoid processes and middle ear are most important. A purulent otitis media that has existed without special symptoms, with periods of exacerbation and apparent intermission for many years, may suddenly, under some unaccountable influence, light up an attack of meningitis, with or without septic sinus thrombosis. On the other hand, meningitis may follow burrowing of the purulent matter which leads to rupture of the tegmen tympani, in connection with or supplementary to extradural abscess. Leptomeningitis may follow operation on the middle ear, such as for the removal of polypi from the tympanic cavity, especially if the removal be attempted through the external ear, for it is next to impossible to render the tympanic cavity and antrum completely aseptic, even when they are approached from behind the ear. It may be secondary to cholesteatomatous middle-ear disease. Next in causative importance to disease of the middle ear and to pyogenic process in the petrous portion, come mastoiditis, furuncle and carbuncle, and diseases of the external ear.

Leptomeningitis may result directly from phlegmonous inflammation of the nose, the veins of the nasal cavity being the pathway of infection, as they are in those cases in which meningitis follows operation on the nose for the removal of polypi and for the cure of hypertrophic rhinitis. When meningitis follows purulent disease of the ethmoid cells, the infection occurs through the lamina cribrosa. Infection of the sphenoidal fossa is most often complicated by thrombosis of the cavernous sinus. Next in frequency is a basal meningitis which eventually extends to the convexity. In these cases it is probable that the infection sometimes takes place in the bone diploë. Purulent disease of the frontal sinuses predisposes to brain abscess more than to meningitis. In fact, the latter is an extremely rare complication.

The existence of the infectious diseases predisposes to the occurrence of meningitis, inasmuch as the bacterial causes of this disease have secured a foothold and base of production and operation in the system. The most important of these diseases are pneumonia, typhoid fever, cholera, dysentery, influenza, malaria, gonorrhœa, and septicæmia. Meningitis occurs sequentially to scarlatina, to measles, to variola, and varicella, but in these cases it is probable that the meningitis is preceded by purulent middle-ear disease, the direct consequence of infection, or that the disease was associated with pneumonia.

By far the most important infectious agency in the production of purulent meningitis is the bacterium known as the pneumococcus. Latter years have shown that this diplococcus is quite as active in the causation of meningitis as in the causation of pneumonia, so that it has been proposed to call it the meningococcus. As it is not the only bacterium that causes pneumonia, so it is not the only one that causes meningitis. It is merely the most common one. As we become more familiar with this diplococcus, we recognize how widely distributed throughout the body it often is. In the majority of cases the nose and mouth are probably the avenues of entrance for these cocci in the production of meningitis. The next most frequent are the maxillary and tympanic cavities and the cribriform labyrinth, on account of their vascular and lymphatic intracranial communications. It is barely possible that when pneumonia exists the cocci may pass from the lungs through the loose connective tissue of the mediastinum, between the œsophagus, the cervical vertebræ, trachea and carotid, and so to the pia. Meningitis due to this bacterium occurs much more frequently independent of pneumonia than as a complication of this disease. Naturally, it often occurs coincidently with or follows diplococcus pneumonia. In pneumonia, as well as in every other disease due to this diplococcus, the cocci are widely distributed throughout the body, and it depends upon the resistance of individual parts that are known to be prone to infection whether or not they will escape.

The capacity of the bacillus of Eberth to cause meningitis is generally

accepted, but the association of meningitis with typhoid fever is extremely uncommon. The colon bacillus is likewise the actively exciting agency in some cases.

A study of the mortuary lists of the great cities in this country during and after the epidemic of influenza which prevailed here in 1891 and since then, shows a marked increase at this time in the number of deaths attributed to meningitis; and it is not unjustifiable to presume that the bacillus of influenza is capable of exciting meningeal inflammation.

Leptomeningitis of a purulent nature may be due to the gonococcus, and a number of cases have been recorded in which this seemed to be the exciting cause.

In addition to all these there are cases of meningitis that are produced by streptococci and staphylococci. Just as in a certain number of cases of pneumonia the only organisms to be found are the two just mentioned, so it is in leptomeningitis. It is by the direct action of these cocci that leptomeningitis arises in such conditions as ulcerative endocarditis and in general septic conditions, such as puerperal septicæmia, and often in localized septic conditions, such as purulent otitis media.

In meningitis of the new-born, which is now happily a rare condition, the source of infection is usually through the umbilicus, although other avenues cannot be denied. It must be recognized that genuine meningitis may occur in the very young infant from almost any of the different causes that we have enumerated.

Etiology of Epidemic Cerebrospinal Meningitis.—This form of meningitis has been considered in the past, and is yet by some, to be a disease apart from acute leptomeningitis, in so much as it is caused by a specific organism and has a clinical history and course which are rather distinctive. But if we were to consider all the forms of meningitis separately because of their individual bacterial causes, it would be an enormous and somewhat profitless task. The real cause of epidemic cerebrospinal meningitis is the diplococcus intracellularis, which was originally described by Weichselbaum in 1887. American bacteriologists have had much to do in firmly establishing the sole causation of epidemic cerebrospinal meningitis by this coccus. Sporadic cases of the disease primary cerebrospinal fever are often caused by the pneumococcus. The disease is apparently becoming more prevalent, especially in this country, for scarcely a year goes by without a report of one or more serious epidemics. The greater prevalence of the disease may, however, be due to its more general recognition and differentiation.

Just as pneumonia may prevail epidemically, just as it may seem for years to have certain centres or foci of occurrence, so may cerebrospinal meningitis. Like other infectious diseases, its place in the mortuary list of great cities is never vacant. Unlike them, it is liable occasionally to devastate sections of the country under the influence of certain antihy-

gienic conditions, particularly those of defective sanitation and improper water supply.

In a general way, the etiological conditions that are true for acute purulent leptomeningitis hold as well for the epidemic form, except that in the latter children fall easy victims to the disease. The pathway of infection in the great majority of cases is through the nasal and buccal cavities. But the intracellular diplococci may reach the meninges through the lymph channels.

Etiology of Tuberculous Meningitis.—The essential cause of meningeal tuberculosis is the tubercle bacillus. Without this the disease does not occur. The etiology may then be considered under the following heads: (1) The conditions that favor or allow the development of tubercle bacilli in any part of the body; (2) The sources of the bacilli and the avenues by which they gain access to the meninges; and (3) The condition of the meninges which allows the bacilli to take up their abode therein and to excite a typical reaction.

The conditions that favor tuberculous infection of the meninges do not differ very materially from those that predispose to tuberculous infection of other serous membranes, such as the pleura, peritoneum, and serous envelopes of joint cavities, except that the pia is more resistant to such infection than are any of these membranes. The age is perhaps the most important indirect factor, as the disease occurs almost exclusively between early childhood and adolescence; the majority of cases occurring between the first and fifth year. The disease is comparatively rare before the end of the first year and after puberty, although naturally cases occur even at the tenderest age and after maturity. It is more common in artificially fed children than in children nursed by healthy mothers.

The disease is somewhat more frequent in the male than in the female sex, as are all forms of tuberculosis. It is much more common in the winter and spring and in temperate climates, on account of the facilities offered for the development and propagation of the bacilli, by the enforced housing which such climate and season entail, and on account of the prevalence at that time of diseases which tuberculous meningitis often follows, such as mumps, whooping-cough, measles, and more rarely scarlet fever.

The disease may occur in families in which there is no tuberculous history; but more often there is a history of tuberculosis in some of the immediate ancestors or relatives. Almost every writer has remarked the frequency of the disease in children who inherit the so-called scrofulous diathesis. All conditions that tend to lower the patient's vitality predispose to tuberculous meningitis by lessening the resistance which the general system, as well as the meninges themselves, offers to the infection. Study, prolonged mental activity, particularly when under conditions that entail physical exhaustion, such as lack of exercise in the open air, defective sanitary surroundings, neglect of hygienic principles, improper

and insufficient food, such as the milk of an impoverished mother, or, in older children, food lacking in fats, are powerful predisposing factors. Falls and blows on the head, and surgical operations seem in many cases to be provocative of an attack. Many children who develop tuberculous meningitis show before their illness marked precociousness, and the energy expended in maintaining this seems to facilitate tuberculous infection of the meninges, particularly when the child's eagerness to study is fostered by parents and teachers. It is more frequent in the children of foreign-born population and those in the lower walks of life than in the native born and well-to-do. It forms a far greater proportion of deaths in the mortuary lists of large cities than in those of small, and it is relatively more frequent in urban than in suburban communities. The disease is predisposed to by the acute infectious diseases, as well as by the acute catarrhal and inflammatory infections of the gastro-intestinal tracts—conditions which make sudden and profound impression upon the nutrition of young children.

The sources of the bacilli are in the vast majority of cases tuberculous infection or foci in other parts of the body, the lungs and pleura, joints and bone, peritoneum, and glands, such as the testicles and lymph glands. Of these, the pulmonary organs are by far the most common sources. The infection of the meninges is by no means always secondary to the occurrence of tubercle in other parts of the body, although in young children it is so as a rule. In adults, on the other hand, primary infection of the meninges rarely occurs. The avenues by which the bacilli gain entrance to the pia are principally the lymph and blood currents. When the source of infection is some tuberculous focus of the cephalic end of the body, such as of the eyes, ears, nose, or throat, that is, from parts which are in connection either directly or through anastomosis with the lymphatic system, the current of lymph is the infection carrier to the meninges. When, however, the tuberculous focus is in a distant part of the body, such as the intestine or the lungs, the blood itself carries the peccant agency. Tuberculous infection of the meninges, like that of the lungs and of the glands, is probably sometimes transmitted from the mother to the child before birth. When infection of the meninges is primary, the bacilli usually reach the meninges through a wound of some part of the head which has direct connection with them. Certain it is that the infection of the meninges from tubercle bacilli taken in from the outside world, without first causing tuberculosis in some other part of the body, is of great rarity except in very young children.

The tubercle bacillus is very slightly saprophytic and consequently has no particular development outside the human body. The bacilli may take up their abode in one part of the body like the lungs or the lymphatic system of the viscera, and without producing lesions attended with symptoms will be the source from which meningeal infection arises.

Among the conditions of the meninges which make them susceptible to the permanent visitation of the tubercle bacilli may be mentioned the different factors which have a capacity to disorder or to deprave the intracranial circulation, whether they arise within the brain, as psychical, or without, such as the effects of trauma, alcohol, or excessive heat. The neuropathic constitution or diathesis may also come under this heading. Blows and injuries to the head may light up a latent tuberculosis.

Non-Infectious Meningitis; Pseudo-Meningitis; Meningitis Serosa.—This is a form of meningeal affection which is not of bacterial origin, and not associated with the presence of bacteria. It is not a true inflammatory process. Clinically and etiologically, two forms may be considered: (1) Due to the prolonged taking of alcohol or some such drug as morphine, cocaine, or chloral, which we may therefore call the toxic variety, and which is nothing else than acute toxæmia of the brain with serous effusion; and (2) Due to injury and acute disease in which the serous effusion is the result of impaired innervation of the meningeal blood-vessels, or of vascular depravity. The etiology of the alcoholic variety needs little further consideration. The immediate occurrence of the symptoms of "wet brain" may be preceded by an attack of delirium tremens, or they may occur during a prolonged debauch. The disease may occur with coexisting disease in other parts of the body, such as pneumonia. In many of the cases of wet brain that come to autopsy there is found a true purulent meningitis, but in these cases the infection has been superadded, and its sources are quite the same as in the ordinary purulent form.

The common attributable causes of serous meningitis in children are some such injury as a fall, a blow on the head, which in themselves do not seem to be of any considerable gravity, and the occurrence of gastro-intestinal diseases. The disease is particularly likely to occur in children in which there are evidences of the rhachitic diathesis. It results in acute hydrocephalus.

Symptoms of Infectious Meningitis.—The symptoms of all forms of acute meningitis are somewhat similar. They vary in individual cases and according to the bacteria that produce them. The prodromal symptoms differ very much in the different varieties. In ordinary infectious meningitis they consist of the usual premonitory symptoms of infection, with pronounced headache, vertigo, and mental irritability. The prominent symptoms of the early stages of the disease are headache of agonizing severity, aggravated by all varieties of mental and physical excitation; rigidity of the neck; nausea and vomiting; retraction of the abdomen; cutaneous hyperæsthesia; localized twitching or general convulsions; vacillating or persistent strabismus; irregular or contracted pupils, and insomnia which leads to flightiness and delirium. This last, with the continuance of the symptoms already enumerated, characterizes the second stage. The amount of

fever will depend largely upon the cause of the meningitis. The ordinary pneumococcus meningitis is rarely accompanied by a temperature above 103° F. If, however, the disease is profoundly aseptic, it may reach 105° or 106° F., and be more or less continuous. During this stage the pulse is rapid, tense, and resistant. The skin is pale, and if the finger nail be drawn across it, it leaves a reddish-white line with purplish-red margins, known as the tache cérébrale. Gradually the headache becomes less severe, and the patient's intellectual faculties become submerged. The twitchings, spasms, and contractures become lessened, the evidences of vasomotor spasm are replaced by vasomotor paresis, the pulse loses its rapidity, and the blood pressure falls. The delirium takes on a more subdued complexion, and the patient passes into the stage of depression. Individual palsies of the cranial nerves may replace previous spasms; the neck becomes less rigid; the patient objects less to handling; the abdomen loses its retracted appearance and may become distended; the pulse becomes more rapid and feeble, the pupils are widely dilated, and respiration becomes irregular in rhythm, perhaps of the Cheyne-Stokes variety. As the coma deepens, all the functions of the body become profoundly deranged, and the general symptoms are those of collapse.

The symptoms vary very decidedly with the locality of the meningeal inflammation and exudation. If it is at the base of the brain, early and profound symptoms will be those referable to the domain of the cranial nerves, and rigidity of the neck; while if the hemispheres have been involved, symptoms of motorial and sensorial irritation, with early appearance of delirium and coma, are most conspicuous. The disease is extremely grave and it is very questionable that any cases of true purulent meningitis ever recover unless the pus is removed artificially.

Symptoms of Epidemic Cerebrospinal Fever.—The symptoms of epidemic cerebrospinal meningitis are of two distinct types, the mild and the severe. The symptoms characteristic of the severe form are the sudden onset and great severity of the irritation symptoms. These may or not be preceded by a profound chill, which if it occurs is followed by prompt, sharp rise of temperature, intense and agonizing headache and backache, associated with rigidity of the neck and back, palsy of some of the ocular muscles, violent delirium, and rapidly deepening coma. Death may occur within twenty-four hours. In the less violent and customary form there are malaise, rigors, dizziness, vertigo, hypersensitiveness to light, noise, and all forms of excitement, and great mental depression. The vertigo, backache, and headache increase, the temperature ranges from 100° to 104° F., the pulse is accelerated and often irregular; and the respirations are shallow and frequent. The skin is almost always the seat of some eruption, erythematous, urticarial or petechial; therefore the disease was formerly called spotted fever. The sphincters are involved early in the course of the disease. Sometimes the

disease begins with symptoms of great severity, which soon mitigate or cease, and to this variety the name abortive is often given. The individual irritation and paralytic symptoms which the disease causes and its sequelæ depend largely upon the segment of the central nervous system which bears the brunt of the irritative or destructive process caused by the meningeal inflammation and exudation. One of the most constant phenomena of epidemic cerebrospinal fever are those to which the designation Kernig's sign, after the Russian who first pointed out its diagnostic significance, is given. If the patient is put in a sitting posture in bed and an attempt made to extend the leg on the thigh there is contraction of the flexors which does not allow the legs to be straightened. This is in marked contrast to the ease with which the leg can be straightened when the patient is in the recumbent posture. This sign is not pathognomonic of epidemic cerebrospinal meningitis. It is present in all forms of meningitis when the spinal meninges are involved.

The general symptoms and accompaniments of epidemic cerebrospinal meningitis are similar to those of other acute infectious diseases.

Symptoms of Tuberculous Meningitis.—The symptoms of tuberculous meningitis do not differ very materially from those of infectious meningitis, except in the occurrence of somewhat characteristic prodromal symptoms and in the prolonged course of the disease which is liable to exacerbations and remissions. In other words, aside from the prodromal symptoms, the difference is one of degree and not of kind. The prodromal period may be of long duration, but the disease may have all the characteristics at the onset of an acute infection. The customary prodromal symptoms are change in the patient's disposition and demeanor, gradual impairment of nutrition, and paroxysmal and intensely severe headaches or darting pains in the head which go and come without obvious cause. After a variable period, the headache becomes more or less constant and of an increasing severity, and its occurrence is associated with seeming involuntary shrieks known as the hydrocephalic cry; vomiting without nausea, projectile in character, of frequent repetition, and not followed by prostration; constipation of the most obstinate character, associated with retraction of the abdominal walls, giving the abdomen the shape of the interior of a boat, and fixedness in the retraction of the head and stiffness of the neck. All of these symptoms may mitigate and the child be apparently progressing toward recovery, when a recurrence of them carries the patient into a paralytic and comatose condition which are the forerunners of dissolution. The disease often runs a most irregular course, and not infrequently a chronic one when the symptoms of hydrocephalus will be the most conspicuous features.

Symptoms of Serous Meningitis; Non-Infectious Meningitis.—The symptoms of alcoholic meningitis, or wet brain, usually come on after a few days of delirium tremens, and are characterized by change in the

variety of the delirium and a gradual sinking into a condition of semi-coma, which deepens day by day until death occurs at the end of from one to two weeks. There are usually rapid pulse, slight elevation of temperature, semi-rigidity of the neck and of the extremities. The patient can generally be partially aroused, either by speaking to him or by pressing upon the peripheral nerves which are almost always sensitive. The general condition is that of a modified typhoid state. The outcome is not necessarily fatal, although it is usually so.

The serous meningitis of children and adults which follows injuries to the head and non-infectious exhausting diseases is very variable in its symptoms and intensity. Usually they do not develop with the abruptness and severity of ordinary leptomeningitis, nor are any of the symptoms, save those of increased intracranial pressure which depends upon the increase of extra- and intraventricular fluid, so intense. The symptoms develop very insidiously, especially in the cases following trauma. They consist of headache, rigidity of the neck, some vomiting, and irregular contraction or dilatation of the pupils. In the severe cases there are often extreme dilatation of the pupils, in addition to the other symptoms, and optic neuritis, delirium and coma, without the development of a temperature above 102° or 103° F. After the occurrence of these symptoms, increasing size of the head, if the disease occurs in patients before the fontanelles have closed and sutures ossified, or signs of intracranial pressure, if after this period, are the symptoms that follow. This form of meningitis can generally be easily recognized, but many do not differentially diagnosticate it from the infectious forms. The majority of cases of meningitis that go on to recovery probably belong to this category. On the other hand, not a few of the cases go into a state of chronic hydrocephalus.

Treatment of Infectious Meningitis.—The prophylactic treatment of acute infectious meningitis is of the greatest importance, in view of the fact that the outcome of these cases is nearly always death, despite the most approved treatment. Considering the relationship which the bacteria of pneumonia, influenza, and other infectious diseases have to the occurrence of meningitis, it is apparent to every one that measures should be taken to keep up the bodily tone, and that excessive fatigue and all hygienic errors be avoided when the mortuary lists of cities or the experience of physicians in the country show that these diseases are rife. Considering the important rôle played by wounds of the head in the causation of meningitis, it is scarcely necessary to emphasize the fact that such wounds should be treated according to the principles of aseptic surgery. No more is it necessary to dilate upon the fact that the danger of secondary meningitic infection from bacterial inflammation of adjacent cavities and passages is lessened in proportion as such conditions are early recognized and given approved treatment.

The next most important feature in the treatment of meningitis is the early discovery and vigorous treatment of all those conditions to which it is secondary. Early diagnosis is an extremely important factor in the treatment of the disease, and to this end the withdrawal of fluid from the lumbar arachnoid space is very necessary—not that I believe aspiration of fluid from the subarachnoid space can be of particular service in ameliorating the disease. If the diagnosis can be made early, then the disease can be treated in a rational manner. Lumbar puncture of the subarachnoid space is a procedure based upon knowledge of the fact that the subarachnoid spaces of the brain and spinal cord are in direct communication, and that both may be injured or injected at the inferior end of this space in the lumbar region. The trifling operation consists in passing a needle into this space between the third and fourth, or between the fourth and fifth lumbar vertebræ, the former level in adults, the latter in children, and about one centimetre to one side of the median line. It is needless to say that all antiseptic precautions are to be taken. The size of the needle varies according to the age of the patient. In young children a needle of the diameter of an ordinary hypodermic needle and from four to six centimetres in length answers the purpose, while for adults the needle should be at least eight centimetres long and one and one-half millimetres in diameter. A mistake most frequently made in first attempts to apply this procedure is that the needle is not carried to a sufficient depth. A needle with a stylet is to be preferred for adults. It seems to be the unanimous opinion of those who have employed this method that an aspirator should not be used. The operation is most easily performed in children when the patient lies on the abdomen across the knees of a nurse, the back being thus forcibly convexed in the lumbar region. In adults the patient should lie on the side, with the knees drawn up and with the uppermost shoulder so depressed as to present the spinal column to the operator, particularly if an anæsthetic is used, which by the way is often advisable, or in the sitting posture with the spinal column flexed on the pelvis if narcosis is considered unnecessary. As soon as the needle enters the subarachnoid space the fluid begins to flow, drop by drop, unless the lumen has become occluded by a piece of tissue or by coagulated blood. The fluid is received into a sterile test tube, and coverslip smears and cultures on Loeffler blood serum are made. The fluid is also stained for the tubercle bacilli. Examination of its physical and chemical composition is of considerable importance in differentiating inflammatory conditions from intracranial growth. That lumbar puncture may some day be the avenue through which medicaments intended to reduce the potency of the inflammation or destroy its excitant can be introduced, as has been hinted by some, seems to me beyond the pale of possibility.

When the diagnosis has been made, or when the presence of the

disease is strongly suspected, the patient should be placed in a large, well-ventilated, dark, absolutely quiet room. The head should be shaved and it with the neck and forehead surrounded with ice-bags. If the patient is robust, and particularly if the meningitis is not secondary to some disease that has exhausted him, topical venesection by wet-cups to the back of the neck, or general venesection is earnestly recommended. Abstracting several ounces of blood from the body robs the system of uncountable organisms, while it does not materially lower the vitality of the patient, because it can easily be substituted by the subcutaneous injection of normal salt solutions. These general measures are the most potent factors in relieving pain next to the hypodermatic injection of morphine; and as the pain must be mitigated, it is more advisable to use them and such innocuous drugs as antipyrin rather than morphine, which always increases intracranial congestion.

Aside from these measures, the treatment is purely symptomatic, unless it be decided to open the skull. If the temperature rises and remains about 102° F., the full-bath of 80° F. of twenty minutes' duration, repeated every three hours is advised, cold applications to the head being kept up meanwhile. If the infection is severe and the temperature higher, a colder bath can be given profitably, and, on the other hand, a lukewarm bath if the temperature is not so high. Prolonged lukewarm baths are serviceable in combating the general hyperæsthesia which is so distressing in the earlier stages of the disease.

All forms of irritant applications to the back of the head, neck, and to the mastoid processes are earnestly deplored. The slight amount of good which they may possibly do is more than counteracted by the pain which they, in common with all forms of stimulation, cause the patient. In the beginning, endeavor should be made to get free action of the bowels, and this can be done most speedily by giving drop doses of croton oil, by mouth if the intervals between the acts of vomiting permit, otherwise by rectum. Stimulative foot-baths and sinapisms to the feet may be used in order to cause derivation of blood from the head, particularly if they do not seem to cause any irritation.

The administration of large quantities of iodide of potassium, even up to an ounce a day, as has frequently been recommended by writers, is strongly deprecated as being at variance with all that we know of the action of that drug and its real therapeutic uses. In not a few cases I have seen disastrous results from its use in cases of serous meningitis and in tuberculous meningitis of long duration. Small doses of one of the bromine salts, from fifteen to thirty grains for an adult, given in the beginning of the disease, is often of service in quieting the pain and in mitigating the severity of the motor symptoms. In the beginning of the disease, after the pain has been somewhat alleviated by local or general blood-letting, the administration of sleep producing agents, such as phen-

acetin, antipyrin, or morphine, can do no harm. Sleep not alone lessens the agony of the patient but increases his resistance to the disease.

In cases in which it has been determined by lumbar puncture and by the course of the disease that the meningitis is profoundly septic or purulent, the question of operation will come up. It is difficult to make any general statements, which will neither be misconstrued nor misunderstood, in reference to these cases. It may be said that operation is advisable in every case in which local suppurative condition of the meninges can be made out. This, unfortunately, is rare. In cases in which pyogenic infection can be traced directly, as from an internal otitis media or an infectious wound, the skull should be trephined as near the point of infection as is feasible, and the greatest pains taken to cleanse and remove the purulent product, particularly if there be septic foci which are causing pressure. The rapidity with which purulent meningitis starting at the convexity of the brain extends to the base and even to the cord, should be borne in mind in deciding upon the advisability of operation and in estimating the benefit to be derived from it. The disastrous outcome of these cases when left to themselves should, however, be taken into consideration. The only chance that the patient can possibly have is from operation, and some surgeons are warmly advocating it. It must also be borne in mind that abscess is liable to follow operation undertaken for the relief of such meningitis, and likewise septic pneumonia, but a sufficient number of recoveries following operation have been recorded to make the procedure justifiable.

Treatment of Epidemic Cerebrospinal Meningitis.—Although the outlook for recovery is nothing like so grave in epidemic cerebrospinal meningitis as it is in ordinary infectious meningitis, there is no specific remedy for the disease, and no effectual method of treatment is known. The experiments spoken of above for lessening the temperature and mitigating the pain and contributing to the comfort of the patient may all be used. The most important feature is the early adoption of measures to maintain the patient's vitality, especially in those cases in which the infection is a profound one. Stimulants and supporting measures are indicated from the beginning of the disease. Aside from these and from care expended in treating the complications and sequelæ of the disease, particularly those that affect the eyes and ears, the general indications for treatment are the same as in every other variety of meningitis.

Treatment of Tuberculous Meningitis.—There are some who still believe that meningeal tuberculosis is uniformly a fatal disease. The unbiassed observer must, however, admit that a sufficient number of undoubted cases of tuberculous meningitis ending in recovery have been recorded to entirely negative this belief. The treatment of the disease is, however, most unsatisfactory. Innumerable plans, medical and surgical, have been adopted, but to-day after they have all had a fair trial,

the physician stands in the presence of tuberculous meningitis with the same feeling of inability to stay its progress as did his predecessor of a generation ago. Meningeal tuberculosis is almost always a secondary process, and prophylactic treatment, therefore, is most important. The details of such prophylaxis coincide entirely with those for the prevention of tuberculous infection of any other part of the body. The basis of their application may be summarized in a line. When the nutrition of a cell or of a tissue is maintained at a physiological state, it is antipathic to the tubercle bacillus. It is all the more necessary to strive to maintain such a degree of nutrition in those who inherit or acquire a tendency to tuberculosis; while in those whose bodies have already given receptivity to the tubercle bacilli the greatest care should be taken to prevent secondary infection of the meninges.

The general directions given for the care of infectious meningitis apply as well to the tuberculous forms, save in the latter no debilitating treatment such as venesection should ever be thought of. The essential point of difference in the treatment of this variety is that iodide of potassium is almost uniformly recommended by writers. The reason for this, considering the outcome of the disease, is difficult to discover, unless it be that the course of the disease is lengthened by its application. Whether this is a desirable feature or not, especially in infants and young children, each one must decide for himself. It has also been recommended that mercury be rubbed into the neck and behind the ears, but this, as well as all forms of counter-irritation, has never been shown to have the slightest virtue. Contemporaneous with the appearance of almost every one of the coal-tar products, substances which not only relieve pain but reduce temperature, has been the report of their service in the treatment of tuberculous meningitis; but aside from their symptomatic use they are of no value. It is known that iodoform in solution when injected into the peritoneum has caused a cure of peritoneal tuberculosis, and this has led to the use of iodoform in tuberculous meningitis. A number of physicians have recorded results of its use; but judicial weighing of the testimony and the evidence forces one to the belief that it must be classified with the useless agencies. Naturally, during the last few years numerous experiments have been made in the treatment of this disease with tuberculin and guaiacol as well as with other medicaments which have acquired a transient or more or less permanent reputation in the treatment of tuberculosis of other parts of the body, especially of the lung. The results have not been at all gratifying.

The operative procedures that have been suggested for the cure of tuberculous meningitis and acute hydrocephalus, of which it is the commonest cause, are also numerous, and although in latter times a few cases have been reported which entirely justify such procedure, at the present writing the treatment has not materially influenced the mortality of

tuberculous meningitis. The object of operation may be palliative or curative, the first to reduce pressure, the second to facilitate the conditions which will bring about fibrous changes in the tubercles and inactivity of the bacilli. The operations that have been recommended are simple trepanning, and tapping the ventricles, or tapping the ventricles through a fontanelle if it be opened, and trepanning and draining the ventricles and subarachnoid space through an opening in the vertebral column. The first plan has been extensively tried, but has never been permanently successful. Recovery has been recorded in a case in which the subarachnoid space was opened in the cervical region, and in a case in which the fluid was withdrawn by lumbar puncture. The operative treatment will be discussed at greater length under the treatment of hydrocephalus, but here it may be said that practically the only procedure justifiable for the relief of tuberculous meningitis is lumbar puncture. All that can be promised from this is that it will ameliorate the pressure symptoms.

The general management of all cases of meningitis is the same, it matters not what the pathological form may be, and it is of the greatest importance that the details of such management be attended to. The pulse, temperature, and bladder should be carefully watched, and when deviations from normal which predict death appear urgent, measures should be adopted for their relief. Frequently the proper use of digitalis, and of other cardiac stimulants, such as strychnine, or of the cold bath, or of the catheter, will tide the patient over some critical period until the recuperative power gains the ascendency. The possibility of bulbar symptoms, particularly difficulty in swallowing, should be kept in mind and proper measures taken to prevent or relieve them. When there is marked dysphagia, nutrient enemata should be resorted to. More is to be gained by attending to the patient's rest and comfort and by combating symptoms as they arise than by any stereotyped plan of treatment.

Treatment of Serous Meningitis.—In the treatment of simple serous meningitis, Quincke, who has had much to do with establishing this form as a recognizable clinical entity, has warmly recommended the administration of mercury internally or by means of inunctions, carried up to the point of slight mercurialization, especially in acute cases. Many of these cases go on to recovery if only the general symptomatic indications be met. The use of salicylate of sodium in from ten to twenty grain doses seems to exercise a very gratifying influence in some cases. If the meningitis is secondary and directly attributable to an injury or disease, measures that have for their object the combating of such causative factors should be adopted early and pushed vigorously.

In treating cases of alcoholic serous meningitis, it should not be forgotten that the disease is a toxæmia with secondary exudative conditions,

brought about by a pathological and asthenic condition of the circulation, and associated with profound general weakness. Measures to combat these should be adopted early and pushed vigorously. The patient should be put upon a liberal, easily digested diet of hot milk, plain or peptonized; concentrated meat extracts, beef juice, peptonized gruels, and nourishing broths. The patient's alimentary tract usually demands special attention, and the treatment should in all cases be begun by giving an effective purgative, such as calomel followed by salines. In almost every instance it will be necessary to give some cardio-vascular stimulant, but if possible, it is urgently advised to avoid alcohol. The diffusible stimulants such as caffeine, muscle stimulants such as strychnine and strophanthus will usually meet the indications. The general treatment of ordinary meningitis as to the use of symptomatic measures that contribute to the comfort of the patient must be applied here as well, and an important point to bear in mind is that such patients are extremely intolerant of depleting measures.

The Treatment of Hydrocephalus.—Hydrocephalus, or water on the brain, is a pathological increase of the intracranial fluid, which may be either in the ventricles in which the fluid is found naturally in largest quantities, or between the parietal and visceral layers of the pia, in a space which it makes for itself.

Clinically, the condition, or symptom as it really is, occurs in an acute and chronic form. The acute varieties are represented by the hydrocephalus of tuberculous meningitis, and of serous meningitis. Pathogenetically, true hydrocephalus is of two kinds, congenital and acquired. The acquired form is almost always secondary and symptomatic. Anatomically, hydrocephalus may be divided into internal when the collection of fluid is predominantly within the ventricles, and external when it is exclusively in the intermeningeal space. The latter is so very rare that it scarcely merits consideration. In the acquired form there is always an increase of fluid within the ventricles. In other words, the acquired form may be accompanied by an intrameningeal collection of fluid, but acquired external hydrocephalus only occurs symptomatically. The most common immediate causes are closure of the foramen of Magendie from inflammatory or degenerative processes, adhesions of the tonsils of the cerebellum to each other and to the sides of the fourth ventricle, and tumors of the brain that encroach upon the ventricular system. Symptomatic hydrocephalus may be present with congenital conditions, such as porencephaly, but such hydrocephalus is not considered congenital, although it may be symptomatic of a congenital condition. Acute hydrocephalus is always a symptom of some disease, congenital hydrocephalus is always chronic.

Congenital hydrocephalus may manifest itself at any time after the fifth month of prenatal life, or during the first months of post-uterine life. Very little is actually known of its causation. Factors that have

been found to precede it so frequently that they are considered to stand in etiological relationship are social transgressions of the parent, such as alcoholism, sexual excess, and hyperfœtation, and such physical disease and stigmata as syphilis, cachexia, and somatic evidences of degeneration. There is no dearth of evidence to show that consanguinity and familiary factors enter into the etiology. Mental shock and physical injury of the mother seem sometimes to stand in causative relationship. The occurrence of infectious disease during pregnancy may also contribute to its development. It is sometimes seen in infants who show other somatic defects, such as harelip, cleft palate, spina bifida, and the like. Cases have been recorded occurring with syringomyelia, but it is likely that these cases were examples of myelohydrosis, the expansion of the central canal being secondary to overdistention of the ventricles. The acquired forms have already been sufficiently considered. A word might be said concerning the so-called spurious hydrocephalus, a condition that occurs in rhachitic children, especially after exhausting diseases, such as cholera infantum and the infectious diseases. As a matter of fact, it is not a spurious hydrocephalus at all, but a genuine accumulation of fluid within the ventricles, and to some extent in the intermeningeal space, which disappears when the nutrition of the blood and the condition of the absorbents become completely rehabilitated.

The treatment of congenital hydrocephalus may or may not be the same as that applicable to acquired hydrocephalus. When congenital hydrocephalus is compensatory for some defect of development of the brain arising during intra-uterine or early post-uterine life, no treatment should be instituted, not alone because no treatment has been suggested that is of the slightest avail, but because it is not desirable to endeavor to overcome a compensatory condition here, any more than it would be desirable to overcome a compensatory cardiac hypertrophy. On the other hand, the treatment of symptomatic hydrocephalus presents a number of problems, although none of them is of greater importance perhaps than the getting rid of the fluid and the prevention of its production. For it matters not whether it be due to tuberculous meningitis, syphilitic basal meningitis, fibrous closure of the foramen Magendie, or adhesion of the tonsils of the cerebellum to each other and to the sides of the fourth ventricle, if the fluid is not got rid of it will eventually cause pressure upon the cerebral cortex that is tantamount to its destruction.

Aside from the causal treatment of hydrocephalus which must be determined in every case, the treatment consists in performing some operation to get rid of a part of the fluid and to prevent its production. For the former I have no hesitancy in recommending the procedure of lumbar puncture which has previously been described. In many cases, however, it is impossible to draw off very much of the fluid in this way on account of the fact that there is a closure of a portion of the channel through

which the fluid of the lateral ventricles must pass to reach the subarachnoid space outside the foramen Magendie, and in such cases it would seem that the method of intracranial drainage recently described by Southerland and Cheyne, and which they have utilized effectively in two cases of chronic hydrocephalus, is the most feasible. They believe that a permanent opening should be made through the cortex into the lateral ventricle. The method of procedure is to trephine the skull, open the dura, and force a catgut drain through the cortex into the ventricle. The dura is then sutured over the brain, and finally the scalp is sutured. Such measures as simple cranial puncture, tapping the ventricles, and the introduction of saline solutions, or a water solution, mixed with iodine, have been abundantly proven to be of no service. It is unnecessary to mention the use of cathartics, diuretics, and diaphoretics, which were formerly administered with the mistaken idea that they contribute to the removal of the fluid, except to warn against their use. The treatment of hydrocephalus, aside from what may be called symptomatic, such as the administration of mercury to children whose parents have had syphilis, or of small doses of iodide of potassium to those in whom there are marked antecedent diathetic conditions, consists in the adoption of measures that contribute to a bettering of the child's nutrition. It is unnecessary to enumerate specifically these measures here. Children who have had a moderate degree of hydrocephalus and in whom the condition has come to a standstill, have often been known to make encouraging mental and physical progress when taken from parents, placed in new environment, and subjected to wholesome discipline and an intelligent dietary. The education of such children should be carried out along the lines now adopted for the instruction of defective children by the advanced school of pedologists.

CHAPTER II.

THE TREATMENT OF ENCEPHALITIS.

By the term encephalitis, inflammation of the brain substance is meant. It is also sometimes spoken of as cerebritis. The former term is to be preferred, as the inflammatory process need not by any means be limited to the cerebrum. Much confusion has arisen in the nomenclature of brain diseases from failure on the part of clinicians and pathologists to concede that the same pathological processes may go on in the brain tissues as in any other tissue or organ of the body. I shall speak of the treatment of encephalitis under three headings: (1) Acute hemorrhagic non-purulent encephalitis; (2) Purulent encephalitis, or brain abscess; (3) Chronic interstitial encephalitis.

Acute Hemorrhagic Non-purulent Encephalitis.

Acute non-purulent encephalitis is in the majority of cases undoubtedly hemorrhagic, and it therefore merits this additional descriptive term. It is commonly described as acute primary hemorrhagic encephalitis in order to emphasize the fact that previous changes have not existed in the blood-vessels. That acute encephalitis may occur, however, without hemorrhagic extravasations goes without saying. Indeed, it is not unlikely that many of the cases which end in complete recovery are of this nature. It is undoubtedly true that many cases which were described by the older writers as cases of meningitis and brain fever were true cases of encephalitis. It would seem no less a fact that not a few of the cases described by modern writers under the name of meningo-encephalitis are cases of the latter disease, especially of the hemorrhagic form. It is fallacious to contend that cases of inflammation of the brain substance, even of the cortical substance, do not exist without coincident inflammation of the meninges. Such a position cannot be held to-day, in view of the many authentic observations which prove that inflammation of the cortex has occurred without such accompaniment. Encephalitis may and does occur secondary to the various forms of meningitis, be they traumatic, septic, tuberculous, or post-infectious; but such varieties will not be considered apart, as the indications for treatment are in no way at variance with the indications in either of these conditions occurring alone.

Etiology.—Acute hemorrhagic encephalitis occurs most frequently in

children up to the age of puberty, although it may occur at any age. This predilection for early life is to be explained on the basis that it sometimes follows the acute infectious diseases, which are more liable to occur at this time. Females are affected more often than males. The disease is dependent in the majority of cases upon some infectious process, although trauma is the only etiological factor that can be elicited in a number of the cases. The two most potent organisms in the causation of this variety of encephalitis are the pneumococcus and the influenza bacillus. Although the organisms are not always found after death, there are not lacking cases in which they have been found. Whether such encephalitis is due to the absorption of toxins which are the result of bacterial activity in some distant organ, such as the lungs and the naso-pharynx, or whether it is dependent upon local action of the bacillus, cannot be said. Acute hemorrhagic encephalitis occurs in connection with other infectious diseases, particularly epidemic cerebrospinal meningitis, typhoid and typhus fevers. In a number of cases it occurs sequentially to ulcerative endocarditis. It occurs also in conjunction with the puerperal state, although it is not improbable that some of the cases that are described under this caption are in reality cases of septic emboli. I have seen two typical cases of the disease occur after heat prostration. It may occur coexistently with inflammation of the brain covering and with thrombosis of the sinuses. Acute abscess of the brain is often surrounded by an area of acute hemorrhagic encephalitis.

Symptoms.—The symptoms are variable and depend upon the intensity, location, and extent of the pathological process. Usually the premonitory symptoms are those of general infection: headache, lassitude, mental irritability, and vomiting. These precede the development of fever, which may reach 105° or 106° F. Evidences of irritation, impairment, or abolition of function of the parts of the brain that are involved then appear. These phenomena are predominantly paralytic, although occasionally they are convulsive. The paralysis may consist of monoplegia, or hemiplegia, partial or complete. Some variety of aphasia or hemianopsia may occur and bespeak involvement of a corresponding specialized cortical area. The mental faculties are obscured, even up to complete coma. The general symptoms are those of an acute infectious disease. Symptoms of meningeal irritation, such as stiffness of the neck, pin-point pupils, and hyperæsthesia, are not usually present. If the seat of the hemorrhagic inflammatory condition is in the pons, the oblongata, or the cerebellum, focal symptoms more or less characteristic of diffuse lesion of these parts, in addition to those already described, or apart from them, will be present. The course of the disease in the majority of cases is not uniformly progressive. It is characterized by periods of exacerbations and remissions. In this way the duration of the disease may extend over a period of from many weeks to several months. The average duration

is about sixteen days. Although the prognosis is grave, it is probable that at least one-half of the cases end in recovery. Very abrupt onset, high temperature, and intense focal symptoms are signs of danger.

Treatment.—The treatment consists in securing absolute rest and freedom from all annoying and disturbing elements. This can best be obtained by putting the patient in a large, well-ventilated, darkened room. The head should be enveloped in ice-bags, while derivative treatment in the shape of a promptly acting cathartic, such as croton oil or calomel, followed by a brisk saline purge, cannot be given too quickly. The endeavor should be made to stimulate the functions of the skin and kidneys, in order to facilitate the removal of waste products. If the patient is vigorous and robust, and not an infant, local bleeding by the application of wet-cups or leeches should be employed. But if the patient's physical condition has been weakened by previous acute disease, such as influenza, these severe measures should not be used. The diet should be of the blandest and most assimilable kind. The intense headache and elevation of temperature are best combated by the administration of phenacetin, salol, and antipyrin. Quinine may also be given, but in small doses, as its physiological action is to cause hyperæmia of the brain and vertigo. If the patient is restless, excited, and delirious, one of the bromine salts, in from ten- to thirty-grain doses, depending upon the age of the patient, should be given occasionally. When the symptoms are of an asthenic character, the most reliable stimulant is strychnine. The reader is cautioned against the use of alcohol and caffeine, which are both contraindicated. High temperature should be controlled by cold ablutions or cold packs. Focal symptoms are not amenable to treatment. The internal administration of mercury and iodide of potassium as antiphlogistics can be of only very slight use. If the disease passes into a subacute or more or less chronic condition, counter-irritation of the skull over such parts of the brain as the symptoms indicate to be the seat of the disease, and the internal administration of iodide of potassium are recommended. Sequelæ of the disease, such as paresis of an extremity, with or without contracture, should be treated by gymnastics, resistance exercises, re-education, and by the application of orthopedic appliances, while mental defects and aphasia require the intelligent co-operation of the physician and pedagogue. The previous existence of an area of hemorrhagic encephalitis predisposes the brain to other infections and diseases, a fact that should not be forgotten by the physician. When such diseases as sinus thrombosis and brain abscess develop simultaneously or secondarily, they should be treated in the usual way, surgically.

Chronic Encephalitis.

Chronic encephalitis is scarcely recognized as a clinical condition, therefore no particular consideration of it will be given here. Pathologically it may be said to occur in one of three forms: I. Syphilitic encephalitis, consisting of the occurrence of diffuse gummatous formations in the gray and white matter of the cerebral hemispheres, particularly in the gray, more rarely in other parts of the brain, and entirely divorced from meningitis and meningo-encephalitis. The starting-point of the new formation which consists of a round-cell infiltration with proliferation of connective-tissue cells with new vascularization, is the tela choroidea and the blood-vessels. II. Hypertrophic nodular gliosis of the brain, consisting of a hyperplasia of the neuroglia cells and fibres leading to gradual atrophy of the neurons, associated with perivascular changes of unknown causation and development. True tuberous gliosis is not an inflammatory disease. Conditions simulating it occur from inherited syphilis and insular sclerosis. III. Diffuse sclerosis of the brain, which occurs under two conditions: (*a*) as a terminal stage of other conditions, such as inherited syphilis, around congenital and acquired defects, such as porencephaly and spots of softening; and (*b*) as secondary to acute, non-purulent encephalitis. Whether or not diffuse sclerosis of the brain occurs as a primary affection is very debatable.

The rules for the treatment of syphilitic encephalitis are embodied in the remarks on the treatment of syphilis of the nervous system (pp. 30–36). Hypertrophic nodular sclerosis is practically an undiagnosticable condition. It may be suspected to exist in young children who are epileptic and idiotic, particularly if there are any anomalies of development or congenital tumors. It is essentially a gliomatosis and entirely unamenable to any form of treatment. The treatment of diffuse sclerosis of the brain can only be spoken of when this condition is sequential to acute encephalitis. In other conditions the diagnosis cannot be made with any degree of certainty during life. When diffuse sclerosis is suspected the treatment that is indicated is the administration of remedies that have a reputation of being inimical to neuroglia and connective-tissue proliferation, such as silver and arsenic; the removal of all conditions that cause unnecessary expenditure of bodily and mental energy; and the adoption of measures to increase the patient's nutrition.

Brain Abscess. Purulent Encephalitis.

Purulent encephalitis results from the activity of pyogenic organisms in the brain substance. When the inflammatory process is circumscribed, and the pus more or less confined to a distinct area, it is called brain

abscess. When it is not limited or circumscribed it is called brain abscess too, although it should be called diffuse purulent infiltration. But as these two conditions are not clinically separable, it is of no importance to make anatomical discrimination.

Of all the diseases to which the brain is liable, abscess of the brain is by far the most important from a therapeutic standpoint. Its causation is reasonably well known; its pathology is clearly understood; and its treatment calls for but one measure. Left alone, it leads to death from sepsis and exhaustion, from rupture into the ventricles or on to the substance of the brain, or from acute hydrocephalus and increased intracranial pressure. Instances have been recorded in which abscesses of the brain have terminated spontaneously in recovery, either evacuating themselves through some abnormal opening in the skull, the result of injury or caries of the bone, or through one of the natural openings, such as the Eustachian tube and nasal passages, the pathway into them being formed through caries of the bone. A second manner in which abscesses are said to have terminated in recovery is by the encapsulation of their contents and the gradual shrinkage of the abscess wall. If this really occurs, it is very rare. It may therefore be truthfully said that the termination of abscess of the brain, if uninterfered with, is in death. This knowledge makes it incumbent upon the physician to spare no time or care that the diagnosis may be made, in order that the one measure in its treatment, viz., surgical interference, may have a fair opportunity to prove its efficacy. As the most important factor by far in the diagnosis of brain abscess is its etiology, it behooves us in discussing the treatment of this disease to give the causative factors careful attention. Until a few years ago abscess of the brain was considered one of the rarities of an individual's experience. The last decade of the nineteenth century has shown that next to meningitis it is the commonest intracranial disease. Hand-in-hand with the wider recognition of the disease has developed the capacity to cope with it. A few years ago the hopelessness of cases of brain abscess was appalling. To-day, if properly diagnosed and skilfully handled, surgical treatment gives far greater prospect of relief in this than in any other intracranial lesion.

Abscess of the brain is clinically and anatomically either acute or chronic. Clinically the acute abscess is characterized by the cardinal symptoms of increased intracranial pressure to which are added the symptoms of an acute septic inflammation. Anatomically it is characterized by the absence of a capsule or limiting membrane, which separates it from the surrounding non-inflamed brain tissue. The inflammatory process in acute abscess of the brain is one of transition from the centre of the abscess, wherein the inflammatory products are wholly purulent, toward the periphery, which is surrounded by an area of hemorrhagic encephalitis. This circumferential hemorrhagic encephalitis may in turn be

surrounded by a zone of serous infiltration. Chronic abscesses are characterized clinically by their protracted course, and by the absence of febrile phenomena, albeit the remaining symptoms of abscess of the brain exist. Anatomically they are distinguished by a capsule or limiting membrane, which separates them from the surrounding tissue. This membrane may be so delicate that it is scarcely discernible, or it may be thick and resistant the result of organization. Pathologically it is an expression of inflammatory reaction in the normal tissues, and it is to be looked upon as an effort on the part of nature to limit the extent of the destructive process. Nature's effort is abortive, however, in almost every instance, for it has been proven that such encapsulated abscesses almost invariably eventually increase in size at the expense of the surrounding tissue, and if not relieved by surgical interference, end in death. It has been speciously contended that this encapsulation of the abscess makes it danger-less, and obviates the necessity of evacuation. Such teachings are most malignant.

Etiology.—The causes of abscess of the brain are direct and indirect. The direct causes are the pyogenic organisms, of which the most important are staphylococci and streptococci. The less important ones, but nevertheless the direct excitants of purulent inflammation of the brain in some instances are the gonococcus, the diplococcus pneumoniæ, the tubercle bacillus, the colon bacillus, the bacillus of typhoid fever, and the actinomyces. Occasionally the parasite oidium albicans is the direct attributable cause. The staphylococci and streptococci are by far the most important. When they are present in a certain degree of intensity, particularly if the nutrition of the brain is lowered and the resistant forces of the tissues are weakened, they invariably cause brain abscess.

The indirect causes of brain abscess or the apparent causes are the most important, because if they did not exist, the direct exciting causes or bacterial causes would not exist. In other words, the indirect causes of abscess of the brain are those from which the pyogenic organisms set out for the brain, or they are the conditions that allow the entrance of the pyogenic organisms into the brain. These indirect causes may be classified as follows:

1. Trauma. Injury to the cephalic extremity.

2. Suppurative process in any of the cavities of the skull. (*a*) Otitic suppurative disease of the middle ear; (*b*) Rhinitic suppurative disease of the nasal and accessory passages.

3. Metastatic abscess. Suppurative process in the lungs and ulcerative endocarditis.

4. Tuberculous abscess. Retrograde and pyogenous change in solitary and conglomerate tubercle.

5. Abscess depending upon the oidium albicans.

Injury to the head is numerically one of the most important causes of

brain abscess. It is variously estimated by different writers at from fifteen to fifty per cent of all the cases. It is probable that from one-fourth to one-third of all cases of brain abscess are of this origin. Trauma to the cephalic extremity may contribute to the occurrence of abscess in two ways: first, by producing an open wound, exposing the outer table of the skull, which gives the pyogenic organisms coming from without a direct pathway to the brain. Brain abscess thus conditioned usually develops within a short time after injury, oftentimes before the superficial wound is completely healed, and it is mediated by extradural inflammation, which may or may not be purulent. Such abscesses are commonly of the superficies of the cortex, often immediately beneath the seat of injury, and are but a part of a general circumscribed purulent inflammation, involving the pia as well. This is the common way in which trauma causes abscess of the brain. Second, occasionally injury to the skull, which does or does not cause an open wound, may cause disordered vascularity of the brain or certain parts of it, which allows pyogenic organisms which may have had a focus in some one of the adjacent skull cavities, to cause purulent inflammation, which would have been resisted were not the parts made vulnerable by the antecedent trauma. It is in this latter way in all probability that ancient trauma is operative to cause brain abscess. It has been proven beyond question that such trauma may antedate the occurrence of abscess, or at least the manifestations of abscess, for many years. In some of these the remote trauma has no part in the causation of the abscess, but in others its pathogenetic rôle (and in the way above indicated) cannot be doubted. The varieties of injury most likely to cause brain abscess are those in which the injured tissues are lacerated by something which carries the infective substance with it; thus penetrating wounds of the orbital cavity, punctured wounds of the epicranium, which penetrate the skull-cap, and compound fracture of the skull are attended with greater liability to this complication than are wounds produced by the surgeon.

The importance of purulent disease of the middle ear and of purulent process in the temporal bone in causing brain abscess is universally recognized. This class of abscesses, indeed, form such a conspicuous part that they are known as otitic brain abscesses. The frequency with which abscess of the brain follows chronic suppurative disease of the middle ear has been variously estimated. The consensus of opinion, however, of neurologists and otologists is that about thirty-five per cent of all cases are traceable to this affection. Considering the curability of chronic otitis media, this is either a reflection on the skill of the aurist or an indication of failure on the part of the general practitioner to point out the danger of such aural conditions to parents. When we consider that suppurative phlebitis occurs sequentially to purulent middle-ear diseases about as frequently as does brain abscess, and that purulent leptomeningitis fol-

lows it about one-half as often, it is readily seen how serious this in itself comparatively slight affection may become. Acute purulent disease of the middle ear holds a more important causative relationship to brain abscess than was formerly supposed. Recent statistics show that this latter condition is responsible for about twenty per cent of otitic brain abscesses. Usually the aural condition is one of several years' standing and of but trifling annoyance to the patient. In fact, in some cases in which brain abscess has been the result of this disease, the sufferer has either completely forgotten the existence of a purulent discharge, or denied that former ear trouble had existed, even after examination previous to or following the operation had shown unmistakable symptoms of such disease. Brain abscess dependent upon ear disease occurs almost always in infancy and early adult life, which is in keeping with the fact that the acute infectious diseases of which suppurative middle-ear disease is unfortunately a common sequel, occur most frequently at this time. The middle-ear disease may or may not be associated with caries of the bony structure in which the middle ear is situated; but as a rule when the abscess occurs sequentially to chronic middle-ear disease, caries of the bone coexists. One of the most dangerous varieties of purulent middle-ear disease is that associated with cholesteatomatous deposits in the attic of the tympanic cavity. Otitic brain abscess may be secondary to mastoid involvement and to septic inflammation of the lateral sinus. They are of more common occurrence on the right side than on the left, which is due to the fact that the bony walls are thinner on this side, due to the greater depth and size of the mastoid fossa.

Rhinitic brain abscesses are, compared with those occurring from purulent inflammation in the middle ear and its accessory cavities, of comparatively uncommon occurrence. In the cases of this origin the purulent focus is commonly in the upper nasal passages or the frontal, ethmoidal, and spheno-maxillary sinuses. Occasionally, the origin of the purulent process is sequential to some operation which in itself is looked upon as somewhat trivial, such as the removal of polypoid growths from the nasal passages, and scraping of one of the sinuses. In a few instances it has followed extraction of one of the molars, the pyogenic process extending to the antrum of Highmore, and thence to the orbital cavities, and so, by the production of a septic phlebitis in the orbital veins, to the brain. In a similar way, phlegmonous process in the orbit causes abscess of the frontal lobe by an extension of the periostitis along the inner and upper border of the wall of the ethmoid to the Glaserian fissure.

Metastatic brain abscesses constitute about one-fourth of the entire number. Septic metastasis is so common from the thoracic organs that brain abscesses of this origin are frequently spoken of as pulmonary brain abscesses. It has been contended by some writers that the brain is the

exclusive seat of metastatic formation from purulent lungs, and that the metastatic foci which result are always multiple. This, however, has been conclusively disproven by the investigations of Martius, who found that in twenty-two cases in which purulent disease of the brain occurred secondarily to pulmonary disease, in six there was metastasis in other organs, and in nine instances solitary abscess of the brain was found. This is entirely in keeping with my own experience and with that of most recent writers. Occasionally brain abscess results by metastasis from other organs of the body, such as the intestines or liver, very rarely from osteomyelitis of the long bone. The diseases with which it has been demonstrated that brain abscess is associated most frequently are purulent bronchitis and bronchiectasis, gangrene of the lungs, purulent pleurisy, and ulcerative endocarditis. In some of the so-called pulmonary brain abscesses lung pigment and elastic fibres have been found in the brain.

Tuberculous abscesses of the brain constitute from five to ten per cent of the entire number. Formerly these abscesses were classified as idiopathic brain abscesses. They are the result of caseation and liquefaction of solitary tubercles or tuberculous conglomerations which experience superadded pyogenic visitation, either from tubercle bacilli or from some more potent purulent excitants. Formerly it was thought that tubercle bacilli were not pyogenic organisms, but this view is no longer held by pathologists. Among the infections that have been followed by brain abscess may be mentioned those of the influenza bacillus, the coccus of erysipelas, and the diplococcus intracellularis.

The cases associated with aphthæ, in which the oidium albicans was found in great numbers in the contents of the abscess, have already been mentioned. A certain number of cases of abscess of the brain occurs in which none of the causes enumerated can be found. It is to these that the name idiopathic has been given. This class is constantly growing less, as bacteriologists are demonstrating the pyogenic properties of organisms that were formerly considered to be lacking this pernicious quality. Naturally, genuine idiopathic brain abscesses do not exist. The use of the term merely signifies that occasionally abscess of the brain of unknown causation occurs.

The Seat of Brain Abscess.—The location of brain abscess stands in definite relationship to the origin of its causative factors. One of the most encouraging features of the therapeutics of brain abscess is, that despite the absence of accurate focal or localizing brain symptoms, we may estimate the seat of the abscess with considerable accuracy from a careful consideration of its origin. In a general way it may be said that the right side of the brain is more frequently affected than the left. This is especially true of otitic brain abscesses, the reason therefor having already been mentioned. Abscesses due to disease of the middle ear are almost always

situated on the same side as the purulent process from which they originate. Their location is either in the temporal lobes of the same side or in the cerebellum, about three times oftener in the former than in the latter. This predilection of the temporal lobes and cerebellum to abscess resulting from middle-ear disease is dependent on a number of causes, the most prominent of which are the thinness of the tympanic roof and the greater liability to implication of the dura over the anterior surface of the bone than that over the posterior wall of the middle ear. It has been definitely proven that when the primary disease is in the superior wall of the middle ear, the resulting brain abscess is in the temporal lobe; while when the posterior surface of the petrous portion or the inner border of the mastoid process is primarily involved the abscess is likely to be in the cerebellum of the same side. This apparent electiveness is dependent upon the different distributions of the veins and lymphatics from the various parts of the middle ear and its immediate bony environment. The dura and brain substance between the primary disease of the ear and the abscess are frequently themselves the seat of the disease, and oftentimes the dura, the pia, and the purulent collection in the cortex are matted together with purulent matter, forming one continuous avenue. In those cases in which there is healthy brain tissue between the abscess of the temporal lobe and the petrous portion of the temporal bone it is probable that infection takes place through the veins that enter into the superior petrosal sinus, or through the perivascular lymphatics. Naturally, brain abscesses of otitic origin are sometimes found in other parts of the cerebrum, such as the occipital lobe, frontal lobe, pons, and cerebral peduncle, but compared with the frequency of occurrence in the locations mentioned, they are very uncommon. In the cases of abscesses from ear disease in which the dura and brain substance between the upper bony covering of the tympanic membrane and the abscess are not diseased, there will be found in some cases a thrombosis of the veins and the sinuses which establishes a direct communication between the original affection and the abscess, or there may be found a purulent infiltration in the sheaths of the seventh and eighth pairs of nerves.

Abscesses due to carious processes in the sphenoid and ethmoid bones and those resulting from purulent inflammation of adjacent cavities, rhinitic brain abscesses, are almost always of the frontal lobe. Twenty cases analyzed by Dreyfus showed that nineteen were in the frontal lobes and one was of the temporal lobes.

Brain abscess due to trauma may occur on the side of the brain which has been the seat of the original injury, or it may occur on the opposite side. Although no such close connection exists between certain parts of the brain and the liability to abscess therein following trauma, as exists in ear diseases, it may be said that, as a rule, abscess of the brain following open wound of the epicranium and cranium is very likely to de-

velop directly beneath the seat of the wound or its immediate environment. Moreover, such abscesses are usually located in the cortex of the brain, the purulent process being more or less continuous with that extending from the wound. On the other hand, abscess of the brain resulting from trauma and delayed in its development until after complete repair of the wound, perhaps months and even years after, is apt to be more deeply situated and as liable to be found in the poles of the brain as anywhere else.

Metastatic brain abscesses are much more common in the left hemisphere than in the right. Their usual location is in the distribution of the artery of Sylvius. These abscesses being of embolic origin, they occur on the left side of the brain for the same reason that ordinary cerebral embolism does. For the same reason likewise these abscesses are more liable to be found in the central ganglia and mid-brain than are abscesses of other origin. Tuberculous abscesses have no special location, except that they are almost invariably deep-seated, situated between the gray matter and the white.

Abscesses consecutive to ulceration of any of the cranial bones and to cranial osteomyelitis are usually situated immediately beneath the original process and associated with, or consecutive to, epidural abscess and septic periphlebitis.

Abscess of the brain not of metastatic origin is usually single, and varies from the size of the end of a finger to that of a fist and larger. Metastatic abscesses are not infrequently multiple and of very different size, the foci of suppuration having no communication. Von Bergmann has reported a case secondary to general pyæmia in which more than a hundred foci of suppuration were present. The color of the pus, the odor, the specific gravity, and other physical characteristics depend in these cases, as they do in all other forms of purulent formations, upon the causative factors. When the destructive process has been very rapid, the color of the pus is reddish-yellow. This is due to the presence of considerable disintegrated tissue. In some cases a disagreeable odor is very pronounced, usually due to a special bacillus, the bacillus pyogenes fetidus. When the pus is greenish-yellow, the bacillus pyocyaneus is responsible.

It has before been said that it depends largely upon the rapidity with which the purulent process develops whether or not the abscess will have a limiting membrane, that is, be encapsulated. If the process has developed rapidly, and if of moderately short duration, there will be no abscess wall. The process of infiltration will taper off from the centre of the abscess cavity where the pus is entirely purulent toward the periphery, through various grades of inflammatory reaction. Such abscesses are common in the cortical gray matter and are often associated with diffuse purulent meningitis. In cases that have been of moderately slow devel-

opment and of considerable duration, pus will be surrounded by a capsule more or less difficult to penetrate. No doubt such abscesses often remain dormant for prolonged periods, giving rise to no expression of their existence, but there are gradually going on a process of attrition in the capsule of the abscess and a slight increase of the abscess cavity at the expense of the surrounding tissues, which eventually cause its rupture into one of the cavities of the brain or on the surface, which proves fatal. This may go on so slowly that the patient has no cognizance of illness. I do not mean to deny that the limiting membrane which encapsulates the abscess is not sometimes capable of bringing the activity of the purulent process to a temporary cessation, and that during such times the pus becomes more or less sterile, perhaps completely so; I merely wish to emphasize the danger of looking upon such an abscess as a benign and dangerless condition.

Symptoms.—The symptoms of brain abscess are briefly: 1, Those due to the infections; 2, Those of intracranial pressure; and 3, Focal symptoms. The first symptoms are present only in the acute abscesses, and consist of rigors or chills, with irregular fever, malaise, mental irritability, and physical depression. Those due to increased intracranial pressure occur both in the acute and chronic forms, more conspicuously in the former, are headache of varying severity, usually profound and deep-seated, vertigo, vomiting, slow pulse, and in about one-third of the cases optic neuritis. Focal symptoms which occur alike in the acute and chronic brain abscess depend entirely upon the part of the brain that is involved. Abscess of the frontal lobes may or may not be accompanied by a degree of mental obscuration. Abscess of the motor areas will be attended by corresponding paralytic manifestations. Abscess in any part of the zone of language will be attended by symptoms which bespeak encroachment upon the various specialized areas of which this zone is made up. Abscess of the cerebellum is often attended by such profound manifestations of vertigo and inco-ordination that they are instantly suspected, but often, unfortunately, the general profound mental and physical asthenia prevents the patient from making complaint of these, and the physician from making tests to reveal their existence. The two most important symptoms aside from the focal symptoms are headache and increasing apathy. Next to these is the dissociation between the pulse and temperature rate in acute abscess and the subnormal temperature in chronic abscess. The most important elements in its diagnosis are consideration of its cause and its bearing on the location of the abscess, due interpretation of focal symptoms, and recognition of the symptoms of intracranial pressure.

Treatment.—The preventive treatment of brain abscess is so important that it cannot be easily overestimated. If it is kept in mind that at least one-third of all cases of brain abscess are due to a disease, otitis

media purulenta, which is ordinarily not looked upon as one dangerous to life, and which is extremely amenable to treatment if handled at the proper time, that is in the beginning, it is readily seen that this condition is the one which demands urgent and careful attention from the physician. Unfortunately, acute purulent otitis is a very common condition, and familiarity with it has bred contempt on the part of physicians and parents, so that it frequently passes into a chronic condition merely from lack of attention to rest, cleanliness, and local applications, such as heat or cold, to combat the inflammation, and paracentesis to allow free discharge and drainage. More unfortunate yet is the fact that when the chronic stage has arrived with its frequent accompaniments of cholesteatomatous deposits and condensing osteitis in the attic of the tympanum and in the mastoid cells, the general practitioner is content to temporize with irrigations, insufflation of drying powders and the applications of astringents. Just so long as this condition of affairs remains and the radical operation, as devised by Stacke and modified by Schwartze—in other words, the Stacke-Schwartze radical operation for the cure of chronic suppurative cholesteatomatous middle-ear disease, which has received the approbation of the otological faculty—is not insisted upon in these cases, just so long will brain abscesses continue to occur as the sequelæ of this condition.

The prophylactic treatment of brain abscess due to trauma of the cephalic extremity and osteomyelitis of the cranial bones has made great progress since the introduction of antiseptics or modern surgery. Brain abscesses sequential to these conditions are gradually becoming less frequent, as it is recognized how important it is to keep wounds of the scalp and cranium in an aseptic condition and that wounds of the dura should be freely opened, drained, and rendered aseptic. No precautionary measures will prevent metastasis from a gangrenous lung or an ulcerated endocardium, nor does treatment seem to rob influenza and the specific bacterial diseases of their occasional malignity in causing this disease. It may be assumed, however, that measures that contribute to the maintenance of bodily vitality tend to prevent all complications, brain abscess among the rest. The same may be said of maintenance of the circulation in children with patency of the foramen ovale in the prophylaxis of brain abscess occurring in "blue babies."

Brain abscesses will continue to occur despite the most rigorous prophylactic treatment. To overcome them there is only one measure: to enter the skull, evacuate the abscess, cleanse it thoroughly, and drain it. At the present day, when the relationship between the sources of infection and the location of the resulting abscess is fairly well known; when the localization of the abscess can be made with considerable exactitude, even though striking focal symptoms are not present; and when the technics of cranial surgery have reached a fairly satisfactory degree of

perfection to delay opening the skull, not with a small trephine, as unfortunately is often done, but with a large generous bone flap that will expose the surface of the brain as large as the palm of the hand, if needs be, is one of the most glaring forms of malpractice. More than this, it matters not whether a diagnosis of the exact location of the abscess can be made, the necessity of entering the skull cavity when one is reasonably certain that brain abscess exists, and following the pathways of infection until it is found, is a duty that the physician owes to his patient. When focal and general symptoms bespeak certain involvement, the earlier that portion of the brain is laid open the greater will be the chances of recovery; for if the physician procrastinates because of an indefinite feeling that the diagnosis is ill-founded, or of an ill-defined sentiency that something miraculous will happen to clear up the symptoms, the disease will have time to make such inroads on the vitality of the patient, both by increasing intracranial pressure and by causing destruction of essential parts of the brain, that the shock alone will be sufficient to sever the patient's hold on life.

Considering the frequency with which two localities of the brain, the temporal lobes and the cerebellum, are the seat of the otitic abscess, and the convincingness with which it has been shown that primary disease of certain parts of the tympanic cavity has relationship to the occurrence of purulent disease of one or other of these parts, it would seem the rational plan of procedure, when the symptoms of otitic brain abscess are lacking in localizing accompaniments, to lay bare the skull over one or both of these areas, electing for the first operation the side indicated, perhaps indefinitely, by certain symptoms. For instance, if to the usual complex of symptoms going to make up the history of a patient with brain abscess there are optic neuritis and persistent vertigo, involvement of the cerebellum would be more probable than that of the temporal lobes, although the latter might be the seat of suppuration and cause these two symptoms in addition to the others. The first opening should therefore be to expose the cerebellum. If after opening the skull, freely incising the dura and exploring the brain substance, not only with a probe, but by free incision into the brain matter, no pus is found, very little danger to the patient's life has been contributed; no more than any one would risk if in a condition to give an opinion, considering the absolutely fatal outcome of this disease when left to itself. On the other hand, in view of the frequency with which rhinitic abscesses are found in the frontal lobes, no reason can be offered why these areas should not be fairly exposed if the etiology of the abscess has been proven. A similar argument holds good for the abscesses following trauma capitis. Naturally, the hesitancy in resorting to surgical procedure will come through uncertainty of diagnosis; then the question to decide is, whether exploration is not justifiable in the search after light. I am of the opinion that it is, providing other

conditions simulating the symptom complex of brain abscesses, which do not call for surgical treatment, can be excluded. But as a matter of fact, the conditions that parallelize symptomatically those of brain abscess are the very ones that demand surgical treatment for their cure: purulent meningitis, septic thrombosis, and brain tumor. All the greater reason, therefore, for deciding upon exploratory opening of the skull. A fact that has been impressed upon me at the autopsy table is that it is puerile after we have decided to open the skull cavity to be content with cutting a small button of bone out of the skull and then passing a probe or a trocar in different directions through the brain, perhaps making only a slight slit in the dura. More than once I have seen on post-mortem examination a large bone flap, made in the area of trephination and thrown boldly back with free incision of the dura, reveal an abscess cavity but an inch away from the place to which it had been localized, and which had eluded the searching probe. The moral of this is that when the mind has been made up to seek for the brain abscess, it should be sought for with the same determination as a conquering army ferrets out bands of ambushed guerillas. Brain surgery has not fulfilled the promise in any cranial disease which it held out a few years ago, except in sinus thrombosis and the disease under consideration; but here it has more than equalled even sanguine expectations. All such operative procedures for the treatment of brain abscesses as opening the mastoid and the like, unless there are special indications for their performance, are to be deprecated. If, on account of the absence of focal symptoms and an inability to trace the causal location of the abscess, the point for election of operation is not indicated, then the general rules for opening of the skull given in any modern treatise on surgery should be followed. More specific rules are to be found in any modern treatise or surgery.

The process that goes on in the abscess cavity after evacuation of the pus is similar to that in abscess of any other part of the body. In acute abscess in which the process of development has been very rapid, even before a semblance of the limiting membrane has formed, escape of the pus is quickly followed by obliteration of the cavity from expansion of the brain about it. In slowly developing and in chronic abscesses, increased intracranial tension does not facilitate emptying of the abscess cavity, and as the remaining pus, as well as that gradually produced from the limiting membrane disappears through draining, the abscess walls fall together and the gap heals by the formation of granulation tissue. As these granulations develop from the bottom, when the reparative process reaches the surface it unites and anchors the pia to the cortical cicatrix. Macewen has shown that the physical after-effects of this is akin in its pathological results to a blow applied to the cranium. It is apt to cause unconsciousness, generally of brief duration, which may, however, recur, and be accompanied by the development of more or less surrounding en-

cephalitis. He thinks also that this cerebral irritation might lead to epileptic fits, although no instances following operation for cerebral abscess are recorded so far as I can determine. If, however, such a condition of affairs should arise, a secondary operation for removal of the cortical scar would be indicated.

The general treatment is the same as for non-purulent encephalitis. Every care must be taken to husband the patient's strength and vitality. Pain and insomnia should particularly be combated. Not infrequently convalescence after operation for brain abscess is a slow one, and measures that contribute to the improvement of the patient's general nutrition must be pushed vigorously.

CHAPTER III.

THE TREATMENT OF INFANTILE CEREBRAL PALSIES.

INFANTILE cerebral palsy is the clinical designation of a distinct class of cases characterized by the occurrence of some degree of paralysis in one or all of the extremities, occurring in young children. Anatomically and pathologically, the clinical picture is dependent upon widely different conditions. Any hemorrhagic, degenerative, or inflammatory condition (with the exclusion of the inflammations caused by pyogenic organisms), prenatal, natal, or post-natal in occurrence, up to the time of second dentition furnishes the anatomical basis of the infantile cerebral palsies. Thus many different pathological conditions, attended by more or less clearly defined clinical entities, are considered here. It includes teratological and defective protal conditions, states of arrested development, disease of the brain caused by deleterious factors mediated through the mother to the child in utero, as well as the many traumatic, inflammatory, and degenerative states of the brain which may occur during the first years of life.

Infantile cerebral palsies may be classified according to the time when the lesion occurs; that is, the disease may be of the primary constituents of the intracranial contents, of the fœtal brain, or of the brain at or after birth. They may also be classified according to the lesion upon which they are dependent. The somatic bases of the infantile cerebral palsies sometimes originate contemporaneously with the development of the primary constituents of the fœtus, and such developmental defects are often the indirect result of pathological heritage. The morbid conditions that are operative on the child during its prenatal life may result through the vascular supply of the brain and consist of inflammation, softening, disintegration, and atrophy, all of which may follow rupture or occlusion of the blood-vessels. The infectious fevers which may attack the fœtus at any period of its existence cause some of the congenital birth palsies by producing embolism and thrombosis of the blood-vessels of the brain, while syphilis by causing thrombosis and rupture seems to be the accountable factor in from five to ten per cent of all the cases. The most important etiological factors acting through the mother are direct and indirect trauma, including under the latter the injuries that may result to the fœtus from injury of any origin to the mother. Accidental and purposeful injury such as blows on the mother's abdomen during the later months of the child's intra-uterine life are sometimes sufficient to cause cerebral palsies. Maternal fright, anxiety, worry, grief, and the

like do not have any relationship to the occurrence of infantile cerebral palsies, save as they cause impairment of the mother's nutrition, which may react unfavorably upon the uterine content.

The causes that are operative at the time of birth and after birth are immeasurably more important than those just mentioned. It is unnecessary to enumerate all the causes that may be contributory to the encephalopathies of natality. They may be summarized in a word—dystocia. The liability to injury of the brain at the time of birth is in direct proportion to the duration of labor. The dystocia causes asphyxia, which is accompanied by a retardation of the circulation, the injurious action of which is soon manifest in the brain, which is not well supplied with collateral circulation. The consequences are that one or more vessels become plugged or ruptured. Postnatal birth palsies may be due to causes operative: (1) on the blood-vessels to produce hemorrhage, embolism, or thrombosis; (2) on the blood-vessels and tissues of the brain to produce encephalitis; and (3) on the meninges of the brain to produce inflammation and hemorrhage. The acute infectious diseases, influenza, diphtheria, typhoid fever, scarlet fever, and the like, may produce infantile palsy in either of the two ways first mentioned. Blows on the head, pyogenic diseases of adjacent skull cavities, and acute infectious diseases may be the antecedent factors of meningeal hemorrhage, sinus thrombosis, and meningitis, upon which the hemorrhage itself is dependent.

The symptoms of infantile cerebral palsy may be divided into motor, trophic, sensory, and psychical symptoms, the first and last being by far the most important. The motor symptoms consist in some degree of paralysis, almost invariably spastic, contracture, convulsions, athetosis, nystagmus, and compulsory associated or choreiform movements. The psychical symptoms consist of limitations of mental development and intellectual expression, varying from the slightest sluggishness in reaction to the environment up to complete idiocy. The trophic symptoms consist principally of retarded development of the paralyzed extremities. The paralysis may assume the form of diplegia, of hemiplegia, of paraplegia, and possibly of monoplegia, diplegia being the commonest form of prenatal cerebral palsy, and hemiplegia of the natal and post-natal varieties. The symptoms of post-natal cerebral palsies are in reality the symptoms of the accident or disease which causes them, and are not to be considered here. It is easily seen that in one case such symptoms may be those of acute encephalitis, in another those of meningeal hemorrhage, and in a third those of rupture of a cerebral blood-vessel or cerebral softening.

Little's Disease.—The designation Little's disease, congenital spastic rigidity, or spasmodic tabes is oftentimes given to a variety of infantile cerebral palsies characterized clinically by spastic rigidity, with slight or no paralysis, of all the extremities, including the head and face, but most

marked in the lower extremity and usually but not invariably accompanied with some degree of mental shortcoming. This condition was first described by an English surgeon, Little, who observed it in children born in premature, difficult, and complicated labor. Some European writers have endeavored to separate this form of infantile cerebral palsies from the large group above described, and to consider it a distinct etiological and morbid entity. Van Gehuchten particularly has striven to show that the rigidity, and in fact all the symptoms are dependent upon incomplete development of certain tracts in the brain, particularly the projections of the Rolandic area. These children, he contends, are born prematurely, before the fibres of the pyramidal projection are completely mature, and the gradual amelioration of the rigidity which usually occurs with the increasing age of the child is synchronous with the development of medullary sheaths to the fibres of the pyramidal projection which renders them functional. There is much to be said in favor of this contention, and it is not unlikely that some cases of infantile cerebras palsy are to be explained in this way. The outlook in these cases is more hopeful than in cases of infantle cerebral palsies dependent upon inflammatory, vascular, and degenerative conditions occurring after birth. Indeed a few cases make gratifying recovery.

Treatment.—The treatment of the infantile cerebral palsies is still most unsatisfactory. The physician can accomplish as little here by the administration of drugs and the utilization of other therapeutic procedures as in any other disease which he is called upon to treat. Parents appreciate the hopelessness of these cases, and anxiously seek the trial of any experiment or procedure which holds out the slightest prospect of relief. So far, no plan of treatment has been devised save the adoption of measures for the prevention of the accidental and unavoidable occurrences upon which the symptom complex is dependent, the subjugation of these accidents and diseases at the time of their occurrence, and the mitigation of symptoms and amelioration of deformities which are consequent upon the intracranial lesion.

Cases of cerebral palsy of infants are rarely recognized until some considerable time after the occurrence of the morbid process upon which they depend. At least this is absolutely true in the experience of the neurologist. They are seen by the general practitioner and by the obstetrician more frequently at this time, but are often not given proper interpretation. The true diagnosis is usually first made when the palsy, the contracture, the choreic or athetoid movements, or the epilepsy and idiocy begin to dominate the existence of the child. This being so, the opportunity of using preventive measures has ceased to exist. The colossal rôle that dystocia plays in the causation of infantile cerebral palsy is by no means sufficiently recognized. The dangers of dystocia are usually considered relative to the life of the child, but the urgency is

very great that they be considered relative to the occurrence of infantile cerebral palsy. The injuriousness of forceps delivery is slight when compared with the far-reaching effects of tedious labor. The severity or hopelessness of many cases of infantile cerebral palsy could be very much mitigated if cases dependent upon acute inflammation of the gray matter of the brain were recognized and treated at the beginning of the disease. The treatment of acute encephalitis, of meningitis, or of any form of cerebral apoplexy, is the same when these conditions occur in earliest childhood as when they occur during later life, and therefore do not call for special enumeration here further than to say that the treatment should be carried out with the same care and urgency that are given to similar diseases occurring in later childhood and adult life. The convulsive phenomena should be combated by the administration of the bromides or the inhalation of chloroform, while the febrile phenomena are overcome by the administration of one of the modern antipyretics in appropriate doses and by the external application of cold. But, as has been said, usually the time for the application of such treatment has long gone by when the patient comes under treatment for the infantile cerebral palsy as a disease. The treatment then consists (1) in the utilization of measures to counteract the deformity, including the paralysis, the contracture, athetosis, and choreiform movements; (2) treatment of the epilepsy; and (3) treatment of the idiocy. Much may be done to overcome the deformities resulting from the paralysis and contracture by the use of modern orthopædic appliances, particularly if the progress of the deformity and contracture is at the same time opposed by the use of massage, and by the intervention of operative surgery. The hopelessness of the deformities in these cases should urge the surgeon to the performance of subcutaneous or open tenotomy, or other surgical operations whenever it is probable that the slightest benefit will follow them.

Very little can be done by either medication or appliances to counteract the athetosis, and very much less can be done to overcome the choreic movements, although in individual cases carefully constructed models in gutta percha from casts of the arm, and splints have been used with service in contributing to the patient's comfort. Occasionally permanent benefit follows such application. Cases have been reported in which forcible stretching of the nerves exposed by the surgeon and prolonged suspension have mitigated somewhat the severity of the choreiform movement. In some cases of athetosis the continual movements have been so aggravated and distressing that amputation of the parts has been proposed and resorted to. In others the excision of the cortex corresponding to the peripheral part that manifests the movement has been done with amelioration of this symptom.

Treatment of the epileptic attacks which occur, in a majority of the cases at least, is also very unsatisfactory. The customary dietetic and

bromide treatment so beneficial in the majority of cases of idiopathic epilepsy counts for little here. If the patient is brought thoroughly under the influence of the bromide and if the digestive tract and avenues of elimination are carefully looked after, the number of epileptic attacks may be diminished and their severity mitigated. But nothing real is gained by such treatment except that the existence of the unfortunate one is made more tolerable. Yet this is the treatment which the majority of cases must receive. When such a plan of treatment is not successful in lessening the number of attacks, the opium-bromide plan should be tried. It consists in the administration of opium from three to six grains daily, according to the age of the child, continued for a period of six weeks, then stopped abruptly and one of the salts of bromine given in mildly toxic doses until the patient is thoroughly under the influence of the latter drug. The dose is then diminished until evidences of its toxicity disappear, and the patient is kept on this minimum quantity until the fits again begin to be frequent and severe, when the opium may be repeated.

Cranial surgery has a narrower field of usefulness in the brain palsies of infancy than in any other disease for the relief of which it has ever been suggested. During the last few years, especially since Horsley showed the skull could be opened with considerable impunity and since Lannelongue claimed a considerable degree of efficaciousness for craniectomy in microcephalic idiocy, this operation has been extensively employed, more in America than anywhere else, for the relief of epilepsy developing with the cerebral palsies of childhood. The results have been carefully estimated, and are found to be woefully disappointing. Surgical interference is useless in cases caused by dystocia, for the very apparent reason that the physician has no conception what the intracranial lesion may be in such a case. The only cases in which the surgeon should be advised to operate are those in which a diagnosis of a focal cortical lesion can be made and those in which symptoms denote the dependence of the symptom complex upon meningeal hemorrhage or cicatrix. In such cases the surgeon should be urged to operate, for nothing is to be lost by procedure. Every case of epilepsy, it matters not what its origin may be, is temporarily benefited by operation on the skull, and in some cases it may be not only fitting but very advisable to resort to operation for such modicum of grateful relief, particularly as there is always a chance that some condition susceptible to partial or complete removal may be found. My own experience with operation for epilepsy associated with the cerebral palsies of childhood leads me to coincide with the opinion of Dana: in the vast majority of cases it exercises merely a pedagogic influence. The operation itself and its entailment of confinement to bed for a prolonged time, careful nursing, regulation of diet, enforcement of obedience, all tend to

influence these unfortunate patients for the better, but this influence is rarely permanent. A degree of permanent relief from operation should be anticipated or promised only in cases in which the symptoms are indicative of focal lesion which can be exposed by the surgeon. When such conditions exist the aid of the surgeon should be evoked. It can then be determined whether or not the lesion is partly or completely an eradicable one.

Something can be done to lessen the severity of the trophic troubles, particularly by the utilization of friction, prolonged warm baths, massage, and dry heat to the paralyzed extremity. If the paralysis is not attended with considerable spasticity, a weak galvanic current to the extremities may have a beneficial influence in facilitating the circulation of the parts. The measures that are appropriate to counteract the trophic influences do not differ materially from those applicable to combat like conditions occurring with anterior poliomyelitis.

Pedagogical treatment is after all the most important for this unfortunate class of patients. The physician can accomplish more by giving this side of the treatment his careful attention while the orthopædic surgeon looks out for deforming contractures than by the pursuit of any other plan. The victims of infantile cerebral palsies and their sequelæ of mental defects and epilepsy are the pariahs of our public schools, and, as a result, any latent capacity for intellectual awakenment and cultivation that they may possess is lost. Parents should be urged to place such children in one of the many private, semi-public, and public institutions which have been founded in many parts of the country for the education of this class of defective children, where mental and physical discipline best adapted to them is administered according to the most approved methods. There they are taught at least the rudiments of personal cleanliness and hygiene, while mental instruction goes hand-in-hand with the acquisition of manual dexterity which is sometimes acquired to such a degree that the patient becomes skilled in some variety of handicraft which makes him partially or completely self-supporting. Such methods of teaching and discipline are superior, in almost every case, to individual treatment by a physician or teacher even in cases in which the financial side of the question needs no consideration, unless the teacher has had large experience with such patients. In truth, the victims of infantile cerebral palsy constitute an important proportion of our defective population, and they should be as carefully and fully provided for by the state as the epileptic and the insane. Physicians should use their influence to bring about such an expansion of our pedagogical and provident systems.

CHAPTER IV.

THE TREATMENT OF MULTIPLE SCLEROSIS.

MULTIPLE sclerosis, insular cerebrospinal sclerosis, disseminated sclerosis, multilocular sclerosis, *sclerose en plaques*, *Herdsklerose*, polynesic sclerosis, Charcot's disease, etc., is one of the commonest degenerative diseases of the nervous system. For many years after it was first recognized it was considered to be one of the rarest. It consists anatomically in the formation of islets of sclerosis or connective tissue through which neuraxons pass without losing their protoplasmic continuity, in different parts of the cerebrospinal axis, but especially the spinal cord and oblongata. Clinically, it varies with the location and extensiveness of the sclerotic areas.

Etiology.—Multiple sclerosis is a disease of early life. It usually develops before the age of complete adolescence; rarely, if ever, after the thirty-fifth year. Many cases occurring in very early childhood have been reported. It afflicts males and females about equally. Although it is improbable that it is either an hereditary or family disease, a few instances have been reported in which it would seem that heredity was a factor. In some of these cases, however, hereditary cerebellar ataxia had not been excluded convincingly. That a marked inherited neuropathic disposition exists in many patients who develop this disease is beyond doubt.

The attributed causes of multiple sclerosis are numerous. Named in the order of their importance and frequency they are: 1. Infectious diseases, such as pneumonia, influenza, scarlatina, measles, typhoid fever, dysentery, malaria, the puerperal state, variola, and diphtheria; 2. Slow poisoning by some of the metals, such as lead, copper, mercury, zinc, and phosphorus; thus indirectly traceable to occupation; 3. Exposure to cold, refrigeration, particularly if associated with hardship and inclement weather; 4. Psychical shock, strain, fright, grief, and social reverses and excesses, such as make a profound impression on the mind and nerve centres; 5. Trauma; 6. Inherited or acquired syphilis, which plays a very unimportant rôle, if any at all. The part played by infection in the causation of multiple sclerosis is in many cases so conspicuous that it must be accorded greatest pathogenetic capacity. How infectious agencies, diverse as they are, operate to cause destruction of tissue in remote areas which have no particular interdependency, with the simultaneous development of degenerative tissue and the processes that mediate these states, is a riddle; and any explanation which is

offered must be theory based on analogy. We have gone no further with blood pathology than to be able to say that it is probable that the products of low forms of vegetable life, as well as certain organic substances, taken in from without and forming compounds with some of the constituents of the blood, are often inimical to the preservation of the nutritive balance of various parts and constituents of the nervous system. Particularly is this true if the latter has been endowed with deficient anatomical and energizing potentiality What determines the destruction of one part after one toxic condition of the blood, or the occurrence of an inflammatory process in one instance and a purely degenerative one in another following a similar infection, we are quite unable to say. That the presence of divers specific organisms in the blood as the result of divers specific diseases may facilitate the activity of a vulgar pathogenetic microbe and that thus a combined infection causes exclusively multiple insular sclerosis as suggested by P. Marie, is fanciful to a degree.

Prolonged exposure to some of the metallic poisons mentioned under number two, preceding the occurrence of multiple sclerosis, would seem to be of more common occurrence in Germany than in this country. Only two cases of this kind have come under my own observation.

Records of cases which show the relationship of exposure, fright, and trauma are numerous, but in seventeen cases which I have had recently under personal observation, in three only has there been such a history. It does not seem to me praiseworthy to take too seriously those cases in which it has been reported that the disease was traceable to a fit of anger. Certain it is that the symptoms may show themselves first after an exhibition of temper, but to admit such coincidence as evidence or even testimony would be tolerated in no other science than medicine. Exposure, exhausting experiences, and the like are often the immediate auspices under which the symptoms of multiple sclerosis occur, but how far they can be considered strictly causative it is difficult to say. No fact is better established in neurology than that these occurrences debilitate the nervous system and thus facilitate nutritive changes which we call disease. The causal relationship of physical injury to multiple sclerosis is thoroughly substantiated. But we are more in the dark as to how it operates than we are in offering a rational explanation of how trauma operates to produce tabes dorsalis. From time to time the importance of inherited or acquired syphilis in the etiology of this disease is urged by some writers. Personal experience and examination of the literature lead me to deny any particular relationship between either inherited or acquired syphilis and the occurrence of multiple sclerosis, despite the fact that it is possible to get a history of syphilis in a very small percentage of the cases.

Multiple sclerosis occurs oftenest at an age before enervating habits or injurious excesses are acquired or indulged in, and thus these factors

do not enter materially into the etiology of the disease, as they do in the causation of some other degenerative diseases of the nervous system. Nevertheless, sexual excesses have been noted by a number of investigators. At present it seems to be rather uniformly admitted that the most pernicious factors are the infectious diseases. Occasionally multiple sclerosis follows in the wake of acute myelitis, and on the other hand, acute myelitis now and then occurs in a patient who has multiple sclerosis.

The predisposing causes of multiple sclerosis are undoubtedly important factors. It is difficult to say wherein this predisposition consists, except to postulate that some slight defect in the original development of the central nervous system renders it liable to decay on encountering factors that would be inadequate to overthrow the vitality of normally developed tissue. The endogenous and congenital origin of multiple sclerosis has recently been put forward with considerable likeliness by Strümpell, but no positive proof of such origin has been offered.

Symptoms.—When we consider that the islets of sclerosis may develop in any or in all of the segments of the cerebrospinal nervous system, or in the different levels of any of its segments, it is not at all surprising that the symptoms will vary in nearly every case. There are, however, certain cardinal symptoms which are sure to develop at some time during the course of every typical case. The most important of these are: 1. Intention tremor, or ataxic tremor, which shows itself on purposeful or reflex movement, especially of the upper extremities, rarely of the cephalic or lower extremites. The rate of tremor is from three to five per second, the oscillations rather regular and subject to exacerbations by mental and bodily excitation. 2. Muscle rigidity and spasticity of all the voluntary muscles of the body; occurring in the emotional muscles, it gives rise to a peculiar spastic expression of the face; in the extremities it causes static spasticity. 3. Exaggeration of the deep reflexes, particularly the knee and ankle jerks. 4. Nystagmus, occasional diplopia, and ocular palsies. 5. Slow, scanning speech, with rhythmical articulation. 6. Some degree of optic-nerve atrophy, particularly bitemporal paleness, in about fifty per cent of the cases. 7. Sensory disturbances when the senory neuron is encroached upon at any level by islets of sclerosis. 8. Vertiginous, apoplectiform, and epileptiform attacks, after which the patient is usually worse. 9. Some degree of mental abnormality, varying from slight exaltation or depression with a tendency to mental vacillation to a considerable degree of dementia. 10. The course of the disease is characterized by periods of more or less brief exacerbations and more or less prolonged remissions.

Atypical forms of the disease which simulate symptomatically the occurrence of chronic disease in some part of the spinal cord or brain are not uncommon.

Treatment.—The treatment of multiple sclerosis may be summarized in two words: rest and nutrition. After the disease has developed there is no medicament that has the slightest effect in influencing the course or in thwarting the progress of the disease. Measures directed toward improving the patient's nutrition, and as much rest as is consistent with bodily health, rarely fail to make the patient more comfortable and more tolerant of his infirmity. No one who sees much of hospital patients can fail to recognize the truth of this. Such patients by very reason of their stay in the hospital with its régime and discipline are more comfortable, and their disease makes slower progress than does that of patients under different auspices.

At different times certain medicinal substances have been advocated in the treatment of multiple sclerosis, but none of them has stood the test of experience. It is probable that in those instances in which a certain drug, such as solanine, has been highly praised that the disease for which it has seemed so beneficial has not been multiple sclerosis at all, but hysteria. If medicines must be given in this disease it would seem most justifiable to give those substances which have attained some remedial reputation in the degenerative diseases of the central nervous system, such as arsenic and nitrate of silver. Indeed, the former is recommended by Eulenburg, and that hypodermically. There can be no doubt that in many instances drugs have secured a reputation undeservingly in this disease, because their administration coincided with or preceded a period of remission or temporary cessation of the symptoms which were a part of the course of the disease. Like in all other organic diseases of the central nervous system, electricity has at one time or another been advocated in the treatment of multiple sclerosis. I have never seen the slightest benefit follow its most determined use. Nor is massage or hydrotherapy of any service save as they may have some effect to improve the patient's nutrition. Patients who are at home in northern climates are much more comfortable in summer than in winter; it follows, therefore, that a more balmy climate should be their winter residence.

It is impossible to speak of the preventive and causal treatment of multiple sclerosis. The endogenous element which consists in improper development of certain components of the cerebrospinal nervous system cannot be coped with. Nor is there apparently any treatment of the infectious diseases that will deprive them of their occasional potentiality to cause multiple sclerosis. Furthermore, its occurrence is not so closely related to occupations that anything can be said on that score. As fright, exposure to wet and refrigeration, are conditions that are practically unpreventable, prophylactic treatment cannot be applied.

CHAPTER V.

THE TREATMENT OF TUMORS OF THE BRAIN.

The brain and the tissues surrounding it offer susceptibility to new growths as do all other tissues of the body. In addition, the brain furnishes the point of origin or soil, in common with the entire nervous system, for a unique growth, viz , the glioma. The term brain tumor is used to cover all new formations within the skull. Thus it includes cysts and aneurisms. Although such new formations as the two last mentioned do not suggest the growths meant by the word tumor in the conventional sense, they nevertheless, by encroachment upon and destruction of tissues in which they develop, cause symptoms identical with those of a solid growth. Therefore they are considered, from a semeiological and therapeutic point of view, with the solid tumors.

In no department of neurology has the advance that has been made in the recognition, interpretation, and treatment of malignant disease been more conspicuous than in the treatment of tumor of the brain. This advance has kept pace with the growth of our knowledge concerning brain localization and with aseptic surgery. Formerly tumor of the brain was recognized clinically, and its recognition was practically tantamount to a warning of speedy death; for medical treatment then, even more than now, was powerless to halt or delay the progress of the disease, save in tumors of syphilitic nature. Unfortunately, we are unable even at the present time, when localization of function to the cortex of the brain is comprehensively known and when the physiology of the encephalon is satisfactorily understood, to take a very sanguine view of the treatment of tumors of the brain. This is due principally to the fact that the vast majority of them are inoperable either because of their location or of their size and infiltrating nature. Operative surgery has not fulfilled the promise, in the treatment of these conditions, which many of the present generation seemed to think that it held out when it was shown that the cranial cavity could be opened with at least a degree of impunity. Experience has shown, however, that its failure to do so is dependent in a large measure upon the inability of the physician accurately to localize the lesion. Despite the wonderful precision with which lesions are often localized there are still comparatively vast areas of the brain which tolerate the encroachment of tumor formation, especially if it occurs in an insidious way, without the production of symptoms that in any way indicate its exact location

An examination of the records of operations for brain tumor during the last few years shows, with one striking exception, that the roseate view which was taken by many of the surgical and neurological authorities of the world a decade ago has been replaced by one of therapeutic gloom and despondency. This may be interpreted as reactionary to an unwarrantably sanguine attitude assumed without sufficient experience. It will be pointed out when discussing the treatment of brain tumors that the pessimistic views which many neurologists of experience now hold in regard to operations for brain tumor are due more largely to the fact that the procedure has been applied or utilized without the same amount of discrimination that is used when operation is advised for growths or disease of comparable malignancy in other parts of the body. Hence to-day it may be said that if in the treatment of tumors of the brain surgical interference is advised and undertaken with the same acknowledgment of its limitations as in that of treatment of malignant growths in other parts of the body, it will be found as satisfactory relatively in the treatment of tumors of the brain as in that of such aforesaid diseases.

The tumors to which the brain is most liable, named in the order of their frequency, are the infectious granulomata, such as tuberculoma and syphiloma; the embryonal and parasitic granulomata, such as glioma, sarcoma, carcinoma, and cysts due to the presence of echinococci; new growths referable to congenital anomalies of development, such as teratoma, angioma, and dermoid formations; and finally, tumors due to disease of the walls and distention of large blood-vessels, aneurisms.

Etiology.—The causation of tumors of the brain is, with few exceptions, still enshrouded in dense obscurity. Naturally, the etiology of the infectious granulomata, such as tuberculoma and syphiloma, is fairly well understood. The same factors that predispose to the occurrence of tuberculous and syphilitic disease in other parts of the body are operative in causing these diseases of the brain. The essential requirements are the bacilli of these diseases, the life history of the former being very well known, the existence of the latter not yet having been satisfactorily proven. The same may be said of the occurrence of parasitic tumors, and of aneurismal dilatation. On the other hand, very little is known of the actual causation of glioma, sarcoma, cholesteatoma, fibroma, and carcinoma, although it may be said that the occurrence of these diseases in the brain is dependent upon the same factors that cause their occurrence in other tissues of the body.

Tumor of the brain is comparatively a very rare condition. Although some surgeons and neurologists encounter such a number of cases that one might be led to think it somewhat common, still the fact that many general practitioners do not see a case in the course of their entire experience is important testimony to the infrequency of the condition.

It has been variously estimated that from one-half to two per cent of all neurological cases are tumors of the brain. In my own experience they constitute 1.3 per cent. Males are afflicted much more frequently than females, the proportion being about two to one. No satisfactory reason can be given for this greater liability of the male, unless it may be accounted for by his being more exposed to physical injury and to the infections. Brain tumor may occur at any age, but it is extremely rare before the end of the first year and during senility. The largest number of cases occur between the ages of fifteen and thirty years, while the decade after this shows the next largest number; and the years of childhood stand third in the order of frequency. Children are particularly liable to the development of tuberculoma, indeed this neoplasm constitutes the majority of cases of brain tumor which occur in children. Naturally, the children of the lower walks living under unhygienic conditions, and those who are deprived of fresh air and suitable food, are more liable to the occurrence of this condition. The same factors predispose to parasitic neoplasms.

The relationship of trauma to the occurrence of tumor of the brain is universally admitted. Just how injuries to the head which are or are not sufficient to produce tangible results contribute to the development of brain tumor is difficult to explain. It seems safe to infer that the disorder of nutrition which such an injury may cause or the still profounder disturbance of vascular equilibrium, amounting even to rupture of minute blood-vessels, may be sufficient to give the infectious agency that is directly responsible for the existence of the neoplasm a nidus wherein to develop. On the other hand, the injury may be the stimulus that excites embryonal remains or teratological defects to developmental activity, and thus causes the growth of tumor. The liability of children to the occurrence of tumor of the cerebellum has been explained on the ground that they are very much more subject to falls, striking the back of the head. It is not at all beyond the pale of possibility that such trauma might excite a gliomatous proliferation in tissue which contains the remains of defective germinal evolution. If the trauma is sufficient to cause a wound, then the scar that results may form the starting-place for the development of the tumor, it being abundantly proven that scar tissue is often the seat of such growths.

Although it is thought that tumors of the brain are more liable to develop in those of a neuropathic constitution, all that can be said is that it has been noted that nervous disease is often found in other members of the family.

Tumor of the brain is very rarely secondary to tumor of other parts of the body, although carcinoma, one of the uncommoner forms of brain tumor, is not infrequently metastatic.

The etiology of intracranial aneurism is the same as the etiology of

aneurism in any other part of the body, the real and predisposing causes being all those factors that are capable of causing degeneration of the blood-vessels, such as the diatheses, the infections, syphilis, and trauma, and the exciting cause being anything that increases intravascular pressure or tends to destroy the support of the intracranial blood-vessels.

Symptoms.—The symptoms of brain tumor are the general symptoms which are due to increase of intracranial pressure, and the focal symptoms which are due to the exaltation or depression of the functions of specialized parts of the brain caused by encroachment upon or destruction of such area by the new growth.

The general symptoms of brain tumor which occur with more or less constancy in every case are. 1. Headache. This has no characteristic feature or locality, although it is by all means the most constant symptom. It is usually of abrupt onset, more or less continuous, liable to unexplainable exacerbations of the most violent kind, sometimes of a dull, benumbing character, in other cases sharp and lancinating. At the height of an exacerbation the patient may be delirious and hallucinatory. Although sometimes localized to the forehead, the occiput, or the side of the head, the area of its greatest intensity does not point the location of the tumor. On the contrary, the tumor may be in a part of the brain most remote from the point wherein the headache is localized by the patient. 2. Optic neuritis, elevation of the papillæ, choked disc. This occurs in from seventy to eighty per cent of all the cases, more frequently when the tumor is of the cerebellum and at the base of the brain than when of the anterior poles of the hemispheres. The most essential point for the physician to bear in mind is that vision is not impaired commensurately with the degree of neuritis, and especially during the early stages of its existence. 3. Vertigo, or subjective sensations of insecurity and dizziness, liable to paroxysmal exacerbations, particularly keeping pace with the headache. This symptom is more constant and of greater severity when the tumor is of the cerebellum or the pons and basal ganglia. It is also often the most distressing symptom when there is palsy of one or more of the ocular muscles. 4. Vomiting, with or without nausea, and often apart from the subjective and objective prostration which one is accustomed to associate with this symptom when it is very severe. Attacks of vomiting are most liable to occur in the morning, and they are severest when paroxysms of headache and vertigo are at their height. 5. Psychical disturbances of variable character and degree, depending somewhat upon the location of the tumor, but more upon the rapidity of development and intensity of intracranial pressure. When intracranial pressure develops rapidly and is of profound intensity, there is almost always a marked degree of lethargy, stupor, and progressive dementia. 6. Slowness of the pulse. 7. Attacks of syncope of variable duration, and sometimes periods of prolonged

stupor and coma. 8. Occasionally alteration of intracranial resonance on percussion.

These general symptoms are present with more or less unvaryingness in every case, and they have been enumerated in the order of their importance and constancy. Usually some one or all of them precede the occurrence of focal symptoms, although in some cases one or more focal symptoms may be the initial manifestation.

Focal symptoms may be entirely wanting. It depends upon the part of the brain in which the tumor is situated whether or not such symptoms will develop. The areas of the brain to which are allocated special function are the Rolandic area on both sides, the zone of language comprising the foot of the third frontal convolution, the superior temporal, and the inferior parietal gyri on the side of the brain opposite to the hand which the individual uses with inherited dexterity, that is, of the left hemisphere in right-handed individuals and of the right hemisphere in left-handed individuals; and the posterior pole of the hemispheres or the cunei, which are the primary visual centres or the cerebral representatives of the retinæ. Specialized functions have been allocated to other areas of the brain, but not so definitely or completely that encroachment upon such areas is manifested by diagnostical significant symptoms. Of the specialized areas that have been enumerated, the convolutions on either side of the fissure of Rolando, known as the motor areas of the brain, are by far best understood. It is tumors of these areas that we are able to diagnosticate satisfactorily and to submit to the surgeon with great prospects of relief. The Rolandic area may be subdivided into thirds, each one of which stands in relationship to different parts of the body, the superior third being concerned with innervation of the trunk and lower extremities, the middle third with the innervation of the upper extremities, and the lower third with the innervation of the cephalic extremity. The symptoms that will be caused by the occurrence of tumor in one of these areas will depend upon the size and rapidity of the growth of the tumor, and upon the degree to which it is confined to individual parts of such an area. If the growth is slow and the extent of it small, the initial symptom may be an exaltation of function, manifested by spasm or convulsion in a corresponding extremity or an individual part of the extremity, as the index finger of the opposite side. On the other hand, if the growth is rapid, there may be a deterioration of function amounting to a paralysis. If the tumor is of the superior temporal convolution in the hemisphere of the brain that has allotted to it the executive speech faculty, then the focal symptom will be sensory aphasia, the most striking symptom of which will be word-deafness. If it is of the inferior parietal convolution of a similar hemisphere, there will be sensory aphasia, the most conspicuous symptom being word-blindness; and if the encroachment is upon the foot of the third frontal con-

volution, there will be sensory aphasia in which the most prominent symptom is the loss of the motor memories of words. Again, if the tumor is of the cuneus of either one of the hemispheres, there will be lateral homonymous hemianopsia; while if the tumor severs the pathway of connection between the cuneus and the centre for visual memories in the posterior end of the inferior parietal convolution, there will be homonymous hemianopsia, plus word-blindness. Thus it will be seen that the focal symptoms depend entirely upon the part of the brain that is subject to encroachment, and these symptoms can be recognized and interpreted only by those who are familiar with the modern teachings of cerebral localization. Tumors of the base of the brain produce focal symptoms earlier and more conspicuously than tumors of any other part of the brain because of the ease and readiness with which they encroach upon one or more of the cranial nerves which are in close juxtaposition in the posterior fossa. Unfortunately, such focal symptoms are of no avail to indicate therapeutic measures, for tumors in these localities are beyond the reach of the scalpel. The focal symptoms that occur with tumors of the base of the brain depend upon the location and size of the tumor and directly upon the cranial nerves or nerve that are implicated.

Tumor of the cerebellum causes the general symptoms that have been enumerated; optic neuritis, vertigo, and vomiting being more constant and profounder than in tumor of the cerebral hemispheres. In addition there is almost always profound disorder of co-ordination, manifested by staggering, reeling gait, ataxia of the upper extremities, and occasionally by nystagmus; and alteration of knee-jerks which are most commonly diminished or lost. Tumors of the vermis are much more liable to cause profound disorder of equilibrium and co-ordination than tumors of the cerebellar hemispheres. It has been thought that the side to which the patient staggers may be taken to suggest, at least, that the tumor is of the opposite side of the cerebellum. It is only when tumor of the cerebellum is associated with paralysis of one or more of the cranial nerves on one side of the cephalic extremity that any focal symptoms of considerable diagnostic importance exist. For instance, paralysis of one seventh or eighth nerve would point to the existence of a tumor in the corresponding hemisphere, if associated with other symptoms of cerebellar involvement.

Treatment.—The treatment of tumors of the brain has very little relationship to the variety of tumor save in two instances, syphiloma and aneurisms. In these, medicinal treatment is most important. If the former is not amenable to medicinal treatment, and is in a locality that permits of its removal, it is subject as well to operative interference, as are also scars remaining after the absorption of syphilitic exudates and syphiloma. Aneurism of the brain is amenable to medicinal treatment only, unless we admit the alleviating influence which ligation of an inter-

nal carotid may have. It will readily be inferred from this statement that an extremely sceptical view is taken of the value of drugs in the treatment of brain tumor. I wish particularly to emphasize this at the outset, because so many writers devote considerable space to an enumeration of the drugs that are reputed to be of service and that should be tried in the treatment of brain tumor. This they do in conformity to precedence and in fear of being thought too radical. Thus, almost every systematic writer upon tumors of the brain feels it incumbent upon himself to discuss the drugs that should be given and the time that should elapse under such administration before the case is turned over to the surgeon. The present writer feels it no less incumbent upon himself to say that in every case of brain tumor in which the localizing diagnosis can be made accurately, and in which there is reason to believe that the tumor is an operable one, not a single day should be allowed to elapse before the skull is opened and the tumor shown to be or not to be operable. This applies to every form of brain tumor save the syphiloma. I do not consider that any trustworthy evidence has been brought forward to show that the administration of arsenic has any influence upon sarcoma or glioma, or that tuberculin in any way influences the course of tuberculoma, or that streptococcus serum has been shown to have any effect upon intracranial sarcoma. It applies also to syphilomata that are not readily responsive to treatment. Therefore, no valid reason can be offered for delaying an attempt to remove what seems to be an operable tumor until a traditional faith in the efficacy of drugs can be destroyed and a morbid conformation to precedence indulged, particularly as valuable time is being consumed during which sudden death may occur for unknown reasons and apparently inadequate cause, and the vitality of the individual so depreciated that he becomes very much less fitted to tolerate the shock of operation. It goes without saying that when there is proof of the syphilitic nature of the lesion, or perhaps even in cases in which the physician strongly suspects the neoplasm to be of such nature that antisyphilitic treatment should be administered for a reasonable length of time before the patient is submitted to an operation, which of course is always attended with considerable danger. But even in these cases no argument worthy of reception can be advanced against operation for syphiloma in an operable location which evidently does not recede under treatment. To put the matter in a different way, it may be said that it seems to the writer to be a clear case of malpractice for a physician to allow a patient with syphiloma in an operable location to be dragged through months of antisyphilitic treatment, during which time irreparable changes go on in the optic nerves, when the indications are that the surgeon could expose and remove such growth. Naturally such instances are rare, but two, at least, have come within my own observation.

The Operability of Brain Tumors.—It has already been said that the

most cogent reason that can be advanced to explain the disappointment that has attended the surgical treatment of tumors of the brain during the last fifteen years is that the cases that have been subjected to operation have been selected without due discrimination. It is manifestly unfair to attribute to surgical unresourcefulness the inability to cope with a brain tumor that has been inaccurately localized, or that is of such situation, size, or nature that it cannot be removed. Yet it was due to the fact that such cases were included that the surgical treatment of intracranial neoplasms was brought into such disrepute in 1898 that the most trustworthy writers on the subject were compelled to state from statistical investigation that surgical interference had succeeded in saving only from four to six per cent of all cases of brain tumor. It was the privilege of Ferrier at this time to show that at least one-third of all the cases that the physician is justified in submitting to the surgeon for operation are amenable to surgical interference, if this is performed with the skill that should be demanded from him who essays to specialize in the field of cranial surgery. It therefore is very important briefly to enumerate the conditions that may be said to make brain tumors operable, particularly as the majority of tumors are so situated or are of such a nature as to preclude the possibility of their successful removal. The percentage of operable cases has been variously estimated to be from twenty per cent to two per cent. It may be said that there has been a gradual decline in the percentage during the past few years. But a conservative estimate shows that from six to eight per cent of all the cases of brain tumor are operable. If it is borne in mind that at the utmost not more than fifty per cent of this per cent of cases that are operable can be saved by operation, it will readily be seen that even the most sanguine estimate of the effects of operation is not a very high one. Only those cases of brain tumor which are situated upon or near the cortex of the brain to which are allocated specialized functions can be considered operable. Some authorities, such as v. Bergmann, restrict this still further by saying that only tumors upon or in the substance of the Rolandic area are operable, but it will be admitted, I think, that this is carrying surgical exclusiveness too far, in view of the localization of function to the gyri constituting the zone of language and the cunei. Tumors of the central parts of the cerebral hemisphere, of the basal ganglia, of the base of the brain, the pons and oblongata, are inaccessible, and after the diagnosis is made the treatment is to adopt measures that will contribute to the patient's comfort and tend to maintain his vitality and prolong his life.

The operability of cerebellar tumors must now be considered. Some recent writers, such as Oppenheim and Bruns, state that cerebellar tumors are inoperable. My own experience, as well as the experience of others, is decidedly inimical to the acceptation of this view, despite the fact that

the statistics of operations done for the removal of cerebellar tumors constitute a very melancholy chapter in therapeutics. Brewer removed successfully a tuberculoma from a cerebellar hemisphere of one of my patients who made a very striking and what seemed to be a complete recovery. The patient died suddenly a few weeks after recovery, when it was found that there were several tuberculomata in the same hemisphere. If the tumor had been an encapsulated sarcoma or a glioma, there is no valid reason why the patient should not have remained entirely well. The experience of a number of others tends to corroborate my own views. Cerebellar tumors are inoperable because of the difficulties of exact diagnosis, and of the greater difficulty which the surgeon experiences in exposing a considerable portion of the cerebellum than of the cerebrum. The procedure which surgeons have latterly adopted overcomes this to some extent, and it may be said that every case of cerebellar tumor in which an accurate regional diagnosis can be made should be looked upon as an operable one.

In some instances it is found after the skull cavity has been entered that the tumor is of such size that it cannot be extirpated. Experience has shown that it is advisable to remove as much of the growth as possible, for in a number of cases thus treated there has been prolonged amelioration of the symptoms. When there is reason to believe from the course of the disease or from its origin that the tumor is metastatic, its removal should be undertaken if the symptoms indicate that it is in a locality that can be reached. The same may be said of multiple tumors —those that can be reached should be removed.

Exploratory and Palliative Operations.—A question that has been very much debated in later years is, whether or not it is justifiable to perform exploratory trepanation to aid in the diagnosis and localization of brain tumor. Most neurologists answer the question affirmatively, while some surgeons who have had large experience in brain surgery are unequivocally opposed to it. The position of the latter is an extremely tenable one, being justified not only by logic, but to some extent by the results of such trepanation. Physicians are inclined to justify exploratory trepanation largely from the fact that in many well-authenticated cases simple opening of the skull has been attended by profound amelioration of the symptoms, in some cases indeed amounting to cessation and to a prolongation of the patient's life.

One of the most striking effects which sometimes attend such simple trepanation, even though there is no escape of cerebrospinal fluid, is the cessation of progress of the optic neuritis, or even the amelioration of this symptom. No satisfactory explanation of this diminution of intensity of optic neuritis has so far been offered, although it is generally accepted that the essential element is diminution of intracranial tension.

Among the palliative operations that may be undertaken in tumor of

the brain, that of lumbar puncture is the most important, particularly because of the ease with which the trifling operation is performed and because of the fact that it is of considerable diagnostic worth in differentiating tumor from inflammatory intracranial conditions such as meningitis and abscess. Lumbar puncture has not been as yet sufficiently utilized as a palliative measure in the treatment of brain tumors to allow us to say how much effect it may have in reducing intracranial pressure. Theoretically, it ought to bring about the same results that puncture of the ventricle does. It should be borne in mind that in cerebellar tumors there is some danger in the use of lumbar puncture. A number of examples have been published to show that sudden death sometimes follows its performance. It need scarcely be said that it should not therefore be utilized when the clinical features of the case indicate that the neoplasm is located in the cerebellum. Another palliative measure that is sometimes made use of is trepanation, followed by puncture of the lateral ventricles. If on opening the skull for an exploratory operation there is bulging of the cortex, which is thought to be indicative of ventricular distention, there are scarcely any objections to this procedure; but it is rarely undertaken entirely as a palliative measure unless under very peculiar circumstances in which it is all-important to preserve for a time the patient's eyesight.

The Dangers of Operation for Brain Tumor.—Different writers make very different estimates of the dangers of operations for removal of brain tumors. It may truthfully be said that the mortality depends in great measure upon the skill of the operator. The one who can avoid sepsis, control hemorrhage, and combat shock, and who brings to the operating-table skill and experience, will find that his skill is frequently rewarded by the life of his patient. Formerly a large number of patients subjected to operations on the cranium succumbed to sepsis. In very late years this result has become uncommon, though it still occurs despite the care which the modern surgeon bestows upon this part of the operation. Hemorrhage is responsible for a considerable number of deaths that follow operation on the skull. The bleeding is not only from the epicranial structures but from the veins of the diploë. We cannot here discuss the means of controlling this hemorrhage, our object being merely to remind him who undertakes the operation that he should be ready to cope with it. The preliminary operation that was proposed a few years ago, of tying the external carotids in order to control the hemorrhage, has never been generally adopted. The most powerful cause of death in operations for brain tumor is undoubtedly shock. Almost every surgeon who does much cranial work has his favorite method of entering the cranial cavity, and as he has had experience with it he uses it more expeditiously than other easier and more rational methods, so that it is difficult to convince him of the superior

advantages of such other methods. Looked at from an unbiassed standpoint and from the standpoint of him who sends his patient to the surgeon it would seem to me that the method of opening the skull with the mallet and chisel is the least advisable because of the cerebral concussion that it causes, while that with the electric saw is the most feasible. The plan of opening the skull as a preliminary operation and waiting before making any attempt to locate and remove the tumor until the symptoms of shock have disappeared, as proposed and practised by Horsley, is most commendable.

Symptomatic Treatment.—The cardinal symptoms of brain tumor are frequently so severe that it is necessary to employ measures that will combat them, even though they have no effect upon the disease itself. The most distressing of these symptoms and the most constant is headache, particularly in the early stages of the disease. It should be ameliorated by absolute rest and quiet, by the use of hot or cold applications to the head and the back of the neck, by local depletion such as the application of leeches or dry cups, and by the use of some of the modern analgesics, such as phenacetin or antipyrin, or of morphine. In many cases it becomes absolutely necessary to administer the latter hypodermatically. There is very little danger of contracting the morphine habit, but even though there were, this should not be allowed to stand in the way of its use. The pain is in many cases so unendurable and is associated with such uncontrollable vomiting that it is absolutely necessary to resort to the administration of morphine when the symptoms are very severe. Phenacetin can be given in from ten- to fifteen-grain doses without danger, particularly after giving a few trial doses of smaller quantity. If its administration or the administration of some other analgesic, such as acetanilid, is decided upon, it can be given in conjunction with strychnine or other stimulants. The bromine salts, when properly administered, can in some instances be made to serve a useful purpose in diminishing meningeal and cortical irritability. The greatest circumspection, however, is necessary in order that the bromides do not add to the patient's lethargy and stupidity. It should never be forgotten that the symptoms of bromide intoxication may parallel those of brain tumor. It has been my own experience to be summoned to a case of what seemed to the physician in attendance to be one of brain tumor and to watch the staggering gait, prostration, mental apathy, and apparent swelling of the optic discs gradually disappear when the bromides were withheld. Séguin has reported a similar case in which preparations to operate had been made. The moral is that the use of the bromides should never be prolonged.

Vomiting is another symptom that often demands particular treatment. Many of the measures spoken of as being serviceable for the relief of headache fortunately have an ameliorating effect on the vomiting.

Whenever it is possible absolute rest should be enforced. Very little is to be gained by giving the customary stomachic sedatives and carminatives. In the early part of the history of brain tumor the patient often suffers from profound insomnia, which if not combated is liable seriously to undermine his constitution and depreciate the vitality which might be expended in resisting the disease. To combat it the ordinary hypnotics are given, such as chloral, chloralamide, sulfonal, trional, and paraldehyde. If sleeplessness is associated with restlessness, throbbing, and sense of tension in the head, the efficaciousness of the elected hypnotic can be very much enhanced by the use of some simple hydriatic procedure, such as the dripping sheet, or the cold wet pack of a half-hour's duration, followed by a cold ablution. This has the effect of drawing the blood forcibly to the surface and diminishing intracranial tension. A hypnotic used at this time will be likely to have the desired effect, although given alone it may entirely fail. In the same way, cold sitz baths of from three to five minutes' duration, running cold water on the feet and legs for a few seconds, or prolonged tepid baths may be serviceable.

Rarely do muscular twitchings, and spasms, demand special treatment, for such symptoms are important localizing symptoms which in some instances at least indicate that the growth is removable. They may occur, however, with unremovable tumors, and then they have to be combated by the use of the bromides and morphine.

The general treatment of brain tumors does not require extended consideration. It should be borne in mind that the natural history of many of these growths is a long one and that their existence is not wholly incompatible with months and even years of comparative comfort and some usefulness. I have had under observation for five years a patient who, in addition to a definite localizable tumor of the brain, had very serious disease of the heart and kidneys, who had been able to do her housework for the greater part of this time. Naturally, the rapidity of the growth and what may be called its index of malignity depends upon the character of the tumor, as well as upon other factors, not the least important of which is the patient's vital resistance. An important duty of the physician is to impress upon the patient that he shall so order his life that no exhausting demands be put upon the body or upon the mind, and that the constructive forces be always in advance of the destructive. The ideal mode of existence would entail a quiet life, free from care or exhausting work, with no demands made upon the patient's energy other than those required to maintain a high state of nutrition. Unfortunately, such conditions are impossible except for the favored few, and the physician must do here as in the treatment of so many other diseases—make the most advantageous compromise possible. It is needless to say that in young persons great care should be taken to guard them against injuries to the head and that school and social entertainments are not to be thought of.

The diet of patients with brain tumor should be one that provides the greatest amount of nourishment and requires the least expenditure of digestive energy. The hours of rest and sleep should be increased. The condition of the organs of elimination, the bowels, bladder, and skin, should be assiduously attended to. During the latter part of the disease the emunctories demand even greater attention than they do earlier, and it may be necessary not only to use the catheter regularly, but to maintain the most scrupulous cleanliness in order to prevent the development of bed sores.

Aside from the symptomatic treatment, the medicinal treatment of tumors of the brain is unfortunately very insignificant, save in two varieties—gumma and aneurism. When either one of these is suspected, then it becomes necessary to carry out the appropriate treatment in the most approved and persistent way. The general and special treatment of syphiloma of the brain are discussed under syphilis of the nervous system, while the treatment of intracranial aneurism may be summed up in a line: rest, the administration of cardiovascular sedatives and iodide of potassium, and the adoption of measures looking toward the cessation of changes in the blood-vessels.

A word may be said concerning the preventive and palliative treatment of tuberculoma. The existence of tuberculosis in other parts of the body or in the ancestors should be sufficient indication and incentive for the adoption of measures to maintain the nutrition of such a person, or to restore it if it is overthrown. These measures are in nowise different from those which can be used to meet the same indications when these exist under other circumstances. The perniciousness of injury to the head and of intellectual stimulation and exhaustion should be kept in mind.

It was stated in the beginning that the treatment of brain tumor is unfortunately most unsatisfactory, and after discussing the various measures that are at our disposal, such must be maintained at the end. We may speak of the prophylaxis of extirpating a malignant growth from one part of the body in order that the brain may not be affected, and of the removal of tuberculous cervical glands for the same reason, but this is not the treatment of brain tumor. The truth is that about six per cent of all cases of brain tumor are susceptible to remedial measures through the scalpel of the surgeon, and through antisyphilitic treatment. About twenty-five per cent of selected cases, that is, cases in which the indications concerning the seat and nature of the growth are such that its removal seems possible, are amenable to surgical treatment. To lower the mortality rate of brain tumors, the most necessary desideratum is a more comprehensive knowledge of the physiology of the brain—in other words, advance in the knowledge of cerebral localization and diffusion of the existing knowledge. To attain this end the symptoms of brain tumor should be most carefully observed and the morbid condition and its exact localization as determined by autopsy recorded.

CHAPTER VI.

THE TREATMENT OF CEREBRAL APOPLEXY.

The term cerebral apoplexy is often used as the synonym of cerebral hemorrhage, but it is more frequently and properly applied to any acute lesion of the blood-vessels which partially or completely occludes the caliber of one or more of them, either temporarily or permanently. Thus cerebral apoplexy may be due to rupture, thrombosis, or embolism of a vessel, or to the œdema that attends acute congestion of the brain. Clinically considered, cerebral apoplexy is a condition characterized by a sudden partial or complete suspension of cerebration, while the vital functions of the oblongata, such as respiration and circulation, are relatively or completely preserved. The distinctive clinical features are the complete suspension of the cerebral functions, and the "stroke" or sudden onset. Pathologically the condition is always dependent upon some change in the brain substance.

The treatment of cerebral apoplexy varies according to the morbid dependency of the disease. I shall consider the treatment of apoplexy due to: 1. Cerebral hemorrhage; 2. Cerebral softening from embolism and thrombosis; 3. Cerebral congestion and œdema; and 4. Apoplexy due to transitory non-organic changes in the blood-vessels.

Cerebral Hemorrhages.

The treatment of cerebral apoplexy due to rupture of a blood-vessel is particularly unsatisfactory if medication is delayed until after the occurrence of the stroke. In other words, preventive treatment is by far the most important. Much can be done to prevent rupture of a cerebral blood-vessel if the symptoms which point to it are early recognized and interpreted, while very little can be done to mitigate the sequelæ of an attack, even though the victim recovers from the acute manifestations.

A discussion of the prophylactic treatment of cerebral hemorrhage necessitates a brief consideration of its causation. This is predisposing and exciting. The causes that predispose to rupture of blood-vessels within the brain are advanced maturity, forty to sixty years of age; the male sex; sedentary and intellectual occupation; prolonged and excessive indulgence in alcoholic drinks, tobacco, and other narcotics; syphilis; the infectious diseases; chronic indigestion, gout, rheumatism, and diabetes; and intoxication by any of the minerals that are known to produce

destructive changes in the blood-vessels, such as lead, mercury, and carbon dioxide. In brief, it will be seen that the predisposing causes of cerebral apoplexy are those that predispose to arterial degeneration, particularly the slowly progressive form known as arteriocapillary fibrosis. Some of the factors enumerated are more potent to cause the degenerative changes in the blood-vessels that predispose to rupture than are others. For instance, in some persons prolonged disorder of digestion, the uric-acid diathesis, the existence of syphilis, and the occurrence of infectious diseases, exercise seemingly a special pernicious action on the blood-vessels to cause some form of arteritis, which in turn produces a condition that makes rupture of them easy. Other individuals will encounter one or all of these etiological factors without developing any change in the blood-vessels. In other words, the personal equation is an important one in estimating the etiology of this accident. This personal equation is largely a matter of heredity and partly one of environment. Persons whose ancestors have died of cerebral hemorrhage or its consequences are more liable to such an accident than those whose family history is comparatively free from vascular degeneration. The element in the heredity that is pathological may manifest itself as a uric-acid diathesis or attacks of gout, in weakened digestion, in want of resistance to the infectious diseases, or it may show itself in none of these ways, the descendant being carried off by rupture of the cerebral vessels at an earlier age than was the ancestor. All these factors must be taken into full consideration in deciding upon the treatment of arteriocapillary fibrosis, which is the prophylactic treatment of rupture of the cerebral blood-vessels.

The objects to be most striven for in the treatment of arteriocapillary fibrosis should be the prevention of further progress of the morbid process and the cessation of the secondary fatty degeneration, not only in the walls of the vessels but in the parenchyma of the organs to which they are distributed. That these may be satisfactorily accomplished, it is necessary so to order the patient's hygiene, dietary, and labors that metabolism is carried on with the highest degree of perfection. An endeavor should be made so to arrange the constructive forces and the expenditure of energy that a careful nutritional balance is preserved. The most important medication, aside from that directed toward the proper and complete adaptation of the ingesta and the facilitation of the excreta of the body, consists in the administration of oxidizing agents and alteratives. Of these the most important by far is iodide of potassium or of sodium. One of these salts should be given in from seven- to fifteen-grain doses three times a day for prolonged periods, interrupting it or diminishing the dose only when it disorders digestion, causes bradycardia, or depreciates nutrition. It should then be interrupted and measures taken to overcome the trifling iodism. It may be combined, when there are special indications in the vascular system for its use, with very small doses of digitalis. The

most satisfactory oxidizing agent is iron when the digestion and elimination of the patient will permit of its use. If the changes in the blood-vessels are profound enough to cause marked disorder of blood pressure, due to the increased peripheral resistance and the diminished force of the heart, the nitrites, particularly the nitrite of sodium and nitroglycerin, the salts of bromine, or aconite in small doses, should be used to tide the patient over any crisis. Such a crisis may be announced by repeated attacks of vertigo, by numbness of one or more extremities, by unwieldiness and diminished dexterity of a member, by muscular prostration, by syncopal attacks, by symptoms of angina pectoris, by thickness of articulation, and by slight mental incoherency. The prophylactic treatment, aside from that directed against progress of the lesion of the blood-vessels, should be to avoid the immediate exciting causes of rupture of the vessels. These are sudden and violent alterations in blood pressure, due to forced bodily and mental activity and the operation of depressing external influences, such as exposure to cold and attacks of indigestion. So far as possible, exhausting intellectual work should be avoided and the patient must be told of the necessity of temperateness in eating and drinking, of the avoidance of alcoholic drinks, which always cause increase of arterial tension followed by injurious depression, and indulgence in acts that put great stress upon the heart, such as coitus and straining at stool.

Treatment at the Time of the Attack.—In a certain proportion of cases of arteriocapillary fibrosis, perhaps in the majority of them, the physician's advice is not sought until after rupture of a cerebral blood-vessel has occurred. The conditions then demand the use of measures that tend to slow the action of the heart and diminish blood pressure, and to bring about coagulation. Unfortunately, we are not in possession of means that tend to check the bleeding in the brain, except those that operate to diminish blood pressure, unless digital compression of the carotid be considered such means. This measure is favorably spoken of by some writers, but it is applicable only in cases seen soon after the onset. The compression should be kept up for half an hour or longer. Ligation of the carotid has been proposed, but has not yet been done to any extent. One of the best ways of diminishing intracranial blood pressure is to increase the peripheral circulation by means of friction to the extremities and to the trunk, revulsives to the extremities, such as hot mustard foot-baths, or sinapisms to the feet. The general indications for treatment at the time of the attack are the same as those for hemorrhage from any part of the body. The patient should be kept absolutely quiet, with the head slightly elevated, and in a room with plenty of air. The most potent way of reducing blood pressure and thus diminishing the amount of hemorrhage is by blood-letting. When patients are seen early in the attack it is my own practice to perform venesection, abstracting from six to sixteen ounces of blood from the median cephalic vein, pro-

viding no special contraindications exist. When there is any doubt concerning the nature of the stroke, and when the patient's general condition does not seem to warrant abstraction of blood, such treatment is dispensed with, and the desired revulsion and depletion are sought through the administration of purgatives. Before giving a purgative it is wise to inquire whether or not the stomach and lower bowel are moderately empty. Although there are serious objections to giving emetics, an overloaded stomach must be emptied despite the fact that the act of vomiting may cause temporary increase of intracranial blood pressure. The distended lower bowel should be emptied by an enema, and this immediately followed by the administration of calomel in two- or three-grain doses, repeated in two hours and followed by a saline draught if the patient is able to swallow. Similar and more vigorous results may be obtained from small doses of croton oil mixed with a generous quantity of castor oil if the patient is able to swallow, or with a small quantity placed upon the tongue if the patient does not swallow. After the patient has had one or two copious passages, the dose should not be repeated for some time unless special indications exist. I have never seen any beneficial results which could be attributed to the application of blister plasters or preparations to the nape of the neck, behind the ears, or other parts of the body, although they are still mentioned favorably by some writers on the subject. After the indications for treatment that have so far been spoken of have been met, the duty of the physician then consists largely in the prevention of such accidents as accumulation of urine in the bladder, collection of mucus in the mouth which by dropping into the respiratory tract may not only facilitate hypostatic congestion but infection, partial cessation of the functions of the skin, and the occurrence of bed sores. The patient should be catheterized regularly, the mouth carefully swabbed out with a mild antiseptic lotion, and the skin kept free and active by the use of warm water and soap. Very little nourishment should be given during the period of unconsciousness unless it is prolonged. Then rectal feeding should be done, particularly if there is any danger that in swallowing some of the food will escape into the respiratory passages. Usually if the patient is going to recover from the attack, consciousness will be at least partially restored after the first twenty-four hours, and the simple food that is indicated, viz., milk and broths, can be given by the mouth.

The next most important duty of the physician is correctly to interpret the indications for using stimulants which oftentimes exist soon after the apoplectic attack begins. Information on this score is to be obtained almost exclusively from study of the heart and of the pulse. Prolonged and profound diminution of arterial tension requires the administration of some such rapidly acting stimulant as caffeine, ether, or camphor, or if the first sound of the heart is particularly weak and the rhythm of the

heart irregular, the administration of a pure cardiac stimulant such as strophanthus or sparteine simultaneously with very small doses of one of the nitrites to diminish peripheral resistance. When it is desired to quiet the action of the heart, aconite, in small and frequent doses, when there is no contraindication to its use, is most serviceable. If these measures do not suffice, when used in connection with those that have been enumerated for bringing about equalization of the circulation, no hesitation should be had in resorting to the intravenous injection of a decinormal saline solution or, as it is sometimes called, artificial serum. Care should be taken, however, not to give it in such large quantities as to put considerable stress upon the fragile blood-vessels or to cause febrile reaction. Rarely is it advisable to administer more than from twenty to thirty cubic centimetres at a time. This can be repeated every hour or two until the manifestations of diminished arterial circulation have been overcome.

Treatment After an Attack.—The treatment of cerebral apoplexy after an attack is of very great importance, although one might not infer this from the very scant attention that is given to the subject in the literature. The same general indications that were spoken of above looking toward the maintenance of the digestive, renal, and cutaneous functions hold here as well as during the attack. As soon as the symptoms of reaction which were caused by the extravasation of blood into the parts surrounding the ruptured vessel have disappeared, treatment should be begun for the purpose of preventing so far as possible the consequences of secondary degeneration, particularly spasticity, contracture, and trophic phenomena. These conditions are to be combated by the rational and persistent use of electricity, massage, graduated exercises, active and passive, and by close attention to the toilet of the skin and to the avenues of elimination. The medicinal treatment directed toward the same end consists principally in the use of measures to counteract further change in the arteries and arterioles, and to maintain the nutrition. The utility of electricity to stimulate muscular contraction and help to preserve the nutrition of the muscles in hemiplegia after cerebral hemorrhage is a very debatable question. It is, however, generally agreed that the use of the galvanic or faradic current is attended with considerable risk in hemiplegia with contracture. Patients with flaccid paralysis following cerebral apoplexy are nearly always somewhat improved by the persistent application of either of these currents, and by that of the static electricity. The virtue of electricity here is unquestionably largely through its power to impress the patient that he is receiving beneficial treatment, while at the same time it may aid in maintaining the nutrition of the parts. Massage is another measure which can be employed, both in the spastic and in the flaccid variety, with considerable benefit. Manual massage is preferable to mechanical. Care should be taken that the treatment is not so severe or prolonged that it fatigues the patient. The most important procedure in helping to restore the para-

lyzed side consists in teaching and in encouraging the patient to practise graduated active and passive exercises, which should be begun at the first reappearance of any degree of voluntary control in the extremities. Anticipating the restoration of a degree of voluntary activity in these parts, the patient should be given passive movements of the paralyzed extremity just as soon as the acute accompaniments of the ruptured blood-vessels have disappeared. This is necessary in order that changes consequent to immobilization do not go on in the joints. Then as soon as the patient can perform even the slightest voluntary movement this should be practised methodically and with precision at stated times every day with the assistance of an attendant.

Precautions should be taken to prevent the development of trophic lesions, by insisting upon scrupulous cleanliness of the skin from the beginning, and by the generous use of dusting powders.

Softening of the Brain from Embolism and Thrombosis (Encephalomalacia).

Softening of the brain is the anatomical condition that results from embolism or thrombosis of one or more vessels of some component of the encephalon. Either of these conditions may occur in the cerebral hemispheres, the basal ganglia, pons and oblongata, or in the cerebellum. Softening of the cerebral hemispheres and basal ganglia alone will be considered here. Cerebral embolism and cerebral thrombosis cause clinically varieties of cerebral apoplexy; and the prodromal, symptomatic, and sequential features which attend their occurrence are as a rule diagnostic. The symptoms are immediately conditioned by the deprivation of blood from certain areas of the brain depending upon the vessel that is plugged; while the remote symptoms are the result of secondary changes that go on in such areas and in the pathways with which they are connected. The prophylactic treatment, of both cerebral embolism and thrombosis, is of vastly greater importance than any treatment after their occurrence. Therefore, it is necessary to consider the etiology of these conditions.

The Etiology of Cerebral Embolism.—The embolus which causes a complete or partial obstruction of one or more of the cerebral blood-vessels has its origin in the vast majority of cases without the brain, and is carried thereto in the arterial circulation. These emboli are either benign or septic. Benign emboli arise from exudative endocarditis with its consequent accumulation of vegetations on the valvular apparatus, which on being separated during states of cardiac excitement or without known cause are carried into the aorta and through the carotids to the brain. They also arise from thrombosis in the heart the result of acquired weakness and degeneration of the heart walls, portions of the clot becoming separated and carried into the circulation the same as from the vegetations of endocardi-

tis. Cerebral embolism may have its origin from the reparative coagulum of an aortic or a carotid aneurism. The embolus may be a particle of fat that has got into the circulation as the result of fracture of one of the long bones and carried through the cardiac circulation, the aorta, and the internal carotid to the brain. Finally, it may have its origin in any part of the venous system which is diseased and be carried by this circulation through the right heart into the lung, there causing pulmonary infarct, which in turn may allow an embolus to get into the return pulmonary circulation through the left heart and thus to the brain. Naturally this is an extremely rare condition. Septic or malignant emboli consist of micro-organisms embedded in the cells of the destructive tissue from the primary focus of ulceration. Septic cerebral thromboses are sequential to ulcerative endocarditis and putrid foci in the lungs. Very rarely is the septic focus in other superficial or deep parts of the body. The remote etiology of cerebral embolism consists of all the factors that contribute to the occurrence of any of the conditions that have just been enumerated. To detail them here would be an unnecessary expenditure of space, as it would demand an enumeration of all the etiological conditions of exudative and ulcerative endocarditis, the various forms of myocarditis, aneurism, pulmonary infarct and septic foci in the lungs, and the puerperal state as well as the causes of thrombosis.

The Etiology of Cerebral Thrombosis.—By cerebral thrombosis is meant coagulation of the blood in one or more of the cerebral blood-vessels. Such a condition results when the reciprocal relations existing between the blood on the one hand and the blood-vessels on the other become disturbed. Thus it is that the remote and immediate causative factors of cerebral thrombosis may be those that are operative upon the blood-vessels, either externally to compress them, or internally to produce an inflammation and degeneration of their walls; upon the blood to produce alteration of its constituents; or upon the cardiovascular apparatus to cause slowing of the blood current. To even enumerate the various causes of endarteritis and arterial degeneration, the antecedent factors of dissociation of the components of the blood that will allow this fluid to coagulate, and of the conditions that cause such slowing of the vascular current that the circulation comes to a standstill in one of the smaller blood-vessels, would require more space than can be given. It must suffice to say that the most potent cause of cerebral thrombosis is endarteritis of syphilitic origin. Syphilitic endarteritis usually occurs in the first decade following syphilitic infection, and not infrequently during the first three or four years. The next most common causes of cerebral endarteritis are the infectious diseases, alcohol, and the mineral poisons. Weakness of the cardiovascular apparatus leading to cerebral thrombosis may be the result of acute diseases, marasmus, senility, and the acute and chronic cardiopathies. The hæmic changes leading to cerebral thrombosis

may be the result of local or general infection of the blood or of interference with the formation and reconstruction of the blood constituents.

Treatment of Cerebral Embolism and Thrombosis.—The treatment of cerebral embolism is quite unlike that appropriate for cerebral thrombosis, and the treatment of either one is unlike that suitable for cerebral apoplexy due to rupture of a blood-vessel. A careful differential diagnosis of these three conditions is therefore very necessary before treatment is instituted.

The importance of prophylactic treatment in either cerebral embolism or thrombosis cannot be overestimated. In the former it consists in the utilization of measures to combat the endocarditis, myocarditis, aortic aneurism, or septic focus in the lungs, and to prevent sudden emotional or physical excitement which might tend to facilitate the detachment of particles of inflammatory or reparative products from these parts. In the latter, prophylactic treatment consists in the adoption of measures to counteract the disease that is narrowing the lumen of the cerebral blood-vessels, to overcome the conditions that are causing disorganization of the constituents of the blood, and to stimulate the cardiovascular apparatus so that it will send the blood through the cerebral blood-vessels with such rapidity that its coagulation is prevented. To meet the indications in the prevention of cerebral embolism, it may be necessary to utilize the most approved methods of treating not only the endo- and myocarditis, the cardiac thrombosis, the aortic aneurism, and the septic focus in the lungs, but the diseases that give rise to them as well. One extremely important point to keep in mind is that absolute physical rest is of the greatest service in preventing the detachment of the embolus which may block up the cerebral blood-vessel. In one case the indications may be to keep a cold compress over the heart that cardiac quietude may be insured and in another case it may be the administration of strychnine or other cardiac stimulant in order to whip up the heart's action so that a cardiac thrombus may not form.

The prophylactic treatment of cerebral thrombosis consists in the vast majority of cases in counteracting the syphilitic endarteritis, and as this is oftenest a late accompaniment of exudative syphilis, both mercury and iodide of potassium are required. The immediate indications in such conditions may be the administration of some such vasodilator as one of the nitrites and a cardiovascular stimulant such as strophanthus or strychnine, to aid the heart in sending blood through the narrow, degenerated, unresilient blood-vessels.

The treatment of cerebral embolism or thrombosis at the time of the attack should consist in studiously doing nothing except keeping the patient quiet on his back with lowered head, in a large, well-ventilated apartment, in which there is freedom from all disturbing influences, until the differential diagnosis between the acute softening and cerebral hemor-

rhage can be made. It is possible that the cerebral embolism or thrombosis will lead to death so rapidly that this differentiation cannot be made. The vast majority of cases, however, pursue a slow course, and careful observation of the mode of onset, the preceding conditions, the age of the patient, and the state of the cardiovascular apparatus, will put us in possession of the information necessary to make the diagnosis. After the differential diagnosis is made, the treatment will depend upon whether the acute softening is due to embolism or thrombosis. If due to embolism, the general indications are to administer drugs that have a sedative influence upon the heart and blood-vessels. If the patient is seen soon after the occurrence of embolism, the heart will be found in labored, vigorous action, while the peripheral vascular equilibrium will be very much disturbed. Under such circumstances, and particularly if the patient is partly unconscious, it is advisable to administer from twenty to forty grains of bromide of sodium, which may be repeated in two hours if it does not have the desired sedative effect. If the patient is not in an asthenic state, the result of disease leading up to the embolus, some of the vasomotor depressants, such as aconite or veratrum viride, may be given, but they should not be repeated more than a few times unless there be special indications such as a continuous, full, soft pulse. The mistake is unfortunately sometimes made of giving cardiac stimulants in cerebral thrombosis, with the view of increasing the blood pressure so as to dislodge the clot. A moment's consideration suffices to show that such an idea is extremely erroneous, and that the administration of vascular stimulants only tends to cause a greater area of softening around the plugged blood-vessel, by causing thereto greater determination of blood.

The general measures that may be of some service in limiting the amount and degree of softening are attention to the condition of the bowels, urinary apparatus, and skin; the application of ice to the head; the enjoinment of absolute rest and quiet; and the adoption of measures to reduce temperature if the fever is above 100° F. Septic emboli are usually multiple and are accompanied by symptoms of general sepsis, as well as those of focal, purulent encephalitis. The treatment does not differ materially from that given for benign embolism, save that if the seat of the embolism in the brain is in the cortex and localizable, the advisability of an operation for the removal of the abscess that has caused it may have to be considered. As a matter of fact, septic embolism terminates in death, no matter what is done. The treatment of the sequelæ of the later stages of cerebral embolism, that is of the symptoms attending the reparative process in the softened area, and the symptoms dependent upon the severance of conduction or association tracts by the softened area and its reparation, will depend very largely upon the seat of the lesion. The symptomatic sequelæ of such lesion may be a variety of aphasia, Jacksonian epilepsy, hemiplegia, or monoplegia, and thus will

require different treatment for different conditions. As a rule, it may be said that the general indications are to maintain the nutrition, to brook no infraction of the laws of mental and physical hygiene, and to administer iodide of potassium. Aside from this, the physician should concern himself to prevent the remote and immediate conditions under which the attack of embolism occurred, so that the patient may be spared a repetition of it.

The treatment of cerebral thrombosis is theoretically and practically absolutely the opposite of that for cerebral embolism and cerebral hemorrhage. Notwithstanding this, it is oftentimes, perhaps in the majority of the cases, given exactly the same treatment. Physicians who are called to a case of cerebral apoplexy feel it incumbent on them because of the gravity of the symptoms and the apparent necessity for urgent measures to give considerable treatment. As a rule, such treatment cannot possibly be of any service unless the differential diagnosis is made, and nothing is to be lost by waiting until this can be arrived at. The immediate treatment of cerebral embolism will depend somewhat upon the immediate antecedent factors. As a rule it may be said that it consists in the administration of remedies that dilate the blood-vessels, while at the same time they stimulate the heart. Such results can be encompassed by the administration of the nitrites and such stimulants as caffeine, strophanthus, and possibly digitalis, although the capacity of the latter to produce slowing of the heart and therefore slowing of the rapidity of the blood flow should not be forgotten. On the other hand, if the coagulum is the result of marasmus or senility, the indications for treatment may be oxygen inhalation, subcutaneous injection of normal saline solution, or the transfusion of blood. The after-treatment of cerebral thrombosis is not materially different from that of cerebral embolism, save in one particular, which is that the measures indicated to counteract the progress of arterial degeneration be given with the greatest care and assiduity. Unless cerebral thrombosis be very profound, the first attack is not usually fatal. The imminent danger is of a repetition of the attack. The indications for treatment vary somewhat with the causal factors of the arterial degeneration, but they differ in nowise from those spoken of under the heading of prophylactic treatment. The sequelæ of cerebral thrombosis are the same as those of embolism, and, like them, are spoken of in this treatise under separate headings.

Congestive and Œdematous Apoplexy.—Apoplectic attacks the result of cerebral congestion and œdema are very rare compared with the former varieties. The pathogenesis of apoplectic attacks from cerebral hyperæmia is not well understood. It is supposed that the circulatory disorder is so profound in the brain that some one or more levels of the intracranial motor projection system is for the time thrown out of function but not permanently diseased. Cerebral hyperæmia never occurs

as a clinical entity apart from the condition to which it is secondary, and the treatment that is required for whatever manifestation of it is treatment directed against that. Œdema of the brain is always secondary to some other pathological condition such as obstruction of the venous circulation within the cranium, or obstruction to general venous circulation, depravity of the blood as in Bright's disease, and general infections, trauma, and acute alcoholism are the commonest causes. The treatment for its symptomatic manifestations, among which occasionally is apoplexy, is the discovery, combating, and removal of the underlying causes.

It is believed that the blood-vessels of the brain may undergo spasmodic contraction as the result of excitation from irritant matters in the blood and from other causes which will temporarily cause loss of function in the brain areas supplied with blood. Such a condition may be attended with the phenomena of cerebral apoplexy including hemiplegia if one of the middle cerebrals is involved. The pathology of this matter is very obscure, and all that can here be said in reference to it is that the reality of such occurrence seems to be well substantiated.

CHAPTER VII.

THE TREATMENT OF APHASIA.

APHASIA is a term used to indicate any disturbance or perversion of intellectual expression. The significance of the term has expanded from the time when its application was used to designate a defect in the verbal expression of an idea until it now includes all defects or disorders of intellectual expression, whether such disorders be the result of disarrangement or destruction of the receptive or of the emissive components of the speech mechanism, or of anything which may be employed as the analogue of speech. Thus a person who, despite the integrity of the peripheral speech mechanism, is unable to utter his own name or to give expression to thoughts which arise in the usual way, has aphasia. If he is incapable of making known his thoughts by the employment of some equivalent of spoken words, such as writing of any sort or by expressive mimicry or pantomime, he likewise has aphasia. Moreover, a person has aphasia who, with the extra-cerebral apparatus intact, is unable to understand the language in whose use he has been trained; does not even recognize, although he hears, the sounds of the most familiar nature and words to which he has for a lifetime been accustomed, such as his own name; although he may be able to read, is unable to write voluntarily and from dictation, and to express his thoughts by words, by symbols, and by pantomime.

Yet even these shortcomings do not comprise all that is meant by aphasia. If a person with normal ocular mechanism looks upon a printed or written page, and the symbols there with which he has previously been entirely familiar convey no meaning to him in the form of approximate thought or idea, such person has aphasia, even though he may understand all that is communicated orally to him, and though he may himself be able to express his thoughts (incompletely and defectively, however) by spoken and written words.

Thus it will be seen that aphasia, in the broad usage of the term, may be the result of conditions by which the patient is unable to part with an expressive equivalent of the idea which has been properly formed. This failure is not confined to words, but includes all modes of expression; or it may be caused by any condition that interferes with the reception of impulses or stimuli that enter into the genesis of ideas used in the construction of internal or external language. As movement in some

form is requisite for the performance of any and all expressions, disorder of these constitute the conditions to which the term motor aphasia is applied, a condition which is equally well expressed by the term aphasia of emission. In the second form of aphasia the sufferer is unable to adapt receptive communications and make them fit the idea represented by the verbal symbol, auditory or visual; that is, he has lost the faculty to adapt the complement of the word to his own idea. It matters not whether these words be spoken or written, or communicated by some equivalent, such as music and pantomime. In a general way, this is the aphasia of reception, or sensory aphasia.

Motor aphasia or aphasia of emission, which was described by Broca as aphemia, and by many writers after him as ataxic aphasia, may be divided into as many forms as there are habitual avenues of exteriorizing thoughts. Ideas are usually exteriorized by spoken words, by written words, by symbols, and by pantomime. Thus, we have aphasia of articulation, or logaphasia; and aphasia of writing, agraphia or logagraphia; asymbolia, and asemia. Aphasia of reception, or sensory aphasia, is also made up of a number of constituents, the two great divisions being auditory aphasia or word deafness, and visual aphasia or word blindness. Each form of aphasia admits in turn of further subdivision. Aphasia may be classified as follows.

1. True Aphasia. Aphasia of apperception due to lesion of any constituent of the zone of language. It may be subdivided into (*a*) visual aphasia, due to lesion of the visual areas and centre; (*b*) auditory aphasia, due to lesion of the auditory areas and centre; (*c*) articulatory kinæsthetic aphasia, due to lesion of the centre in which are stored memories of the movements necessary to externalize the word by speech.

2. Sensory Aphasia. Due to lesion of the central and peripheral sensory pathways, leading to the zone of language.

3. Motor Aphasia. Due to lesion of the motor pathways, over which motor impulses travel in passing to the peripheral speech mechanism.

4. Compound Aphasia. Any combination of two or more of these.

Such it seems to me would be amply sufficient to include every form of aphasia that one meets with at the bedside. Although it would not fit all the forms of aphasia that may be posited theoretically, physicians may claim the privilege of not crossing bridges before they come to them. Nevertheless, after this has been said, it seems to me that everything should be done to make our classification conform with the divisions that have been put upon aphasia by other writers, and so long as no principles are sacrificed, this may be done. I shall therefore adopt the following classification as a working one, and desire to say at the outset that the word motor aphasia is never used synonymously in my own mind with the word ataxic; moreover, that the word motor is retained to apply to

that form of aphasia characterized anatomically by lesion of Broca's convolution, solely because such usage has been consecrated by time. The images stored up in this centre are genetically sensory, the result of motion.

Motor Aphasia.		1. Lesions of the kinæsthetic-articulatory centre, Broca's area (and probably of the associative fibres connecting them with the cortical motor areas in the Rolandic region), causing articulatory word amnesia. 2. Lesion of motor fibres which convey speech impulses: subcortical motor aphasia. Pure motor aphasia of Dejerine. 3. Lesion of any part of the peripheral neuromuscular apparatus serving articulate expression: dysphasia, lallation, alallia.
Sensory Aphasia.	*Auditory.*	1. Lesion of the receptive cells constituting the auditory centre causing abolition of function, word deafness and its entailment. 2. Lesion of the subcortical sensory tract: subcortical auditory aphasia; pure auditory aphasia of Dejerine.
	Visual.	1. Lesion of the receptive cells of the higher visual centre causing word amnesia, graphic and visual word blindness, and its entailment. 2. Lesion of the subcortical tract and the primary visual centre which entails loss of the recognition of things, words, and objects: that is loss of their significance, object amnesia or apraxia, or true neural blindness.
Total or Compound Aphasia.		Lesion of the entire zone of language: disturbed function of visional, auditory, kinæsthetic-articulatory centres.

Etiology.—Etiologically aphasia may be classified as organic and dynamic. The organic varieties are the result of injury, new growths, inflammatory and vascular lesions of the coverings of the brain and the brain substance. The principal vascular lesions are: rupture of blood-vessels and occlusion of their calibre either from embolus or thrombus, and the consecutive changes dependent thereon. The lesion of the blood-vessels may be an inflammatory one, but even then it is not improbable that the pathogenesis of the lesion is the direct result of a septic or infectious process that causes infectious emboli and thrombi. The traumatic conditions that may produce aphasia are bullet and stab wounds, depressed fractures of the skull, and injuries producing meningeal hemorrhage.

The inflammatory lesions that are most commonly causative of aphasia are acute hemorrhagic encephalitis and brain abscess, meningitis of the convexities, especially the tuberculous variety, and syphilitic pachymeningitis. Under the dynamic forms may be included those in which no organic lesion is responsible for the development of aphasic symptoms. The term dynamic is used merely as a convenience in preference to the conventional functional. The dynamic variety includes aphasia occurring with the neuroses and psychoses which are not yet proven to be depen-

dent upon recognizable brain lesion, of which epilepsy, neurasthenia, and hysteria may be taken as examples. It also embraces most of the cases of aphasia occurring with toxæmia, such as uræmia, diabetes, and gout; although aphasia in some of these cases, especially aphasia occurring with uræmia, is often dependent upon an organic vascular lesion of cerebral blood-vessels. Aphasia caused by the vegetable poisons, santonin, belladonna, tobacco, etc., is almost invariably of the dynamic form. The aphasia that sometimes occurs in individuals who have been poisoned by lead and copper, may be of the dynamic variety or it may be a focal manifestation of the encephalopathy that these poisons occasionally cause. The dynamic aphasias also include the aphasic speech disturbances occurring with neuralgic affections of a migrainous order, epilepsy, hysteria, and nervous exhaustion, those occurring with forms of insanity that have no known anatomical basis, and finally the comparatively insignificant number which are attributed to fright, anger, so-called reflex causes, such as intestinal worms, and the transitory aphasias from loss of blood.

Ordinary etiological factors, such as age, sex, and occupation, have no bearing on the causation of aphasia, because it is itself a symptom, and it results only when the diseases of which it is a symptom occur or are prone to occur; but as aphasia is so often associated with cerebral apoplexy, and as cerebral apoplexy occurs usually in late maturity and advanced age, it follows that aphasia is seen oftener in people beyond fifty years of age. Nevertheless it would be misleading to leave this statement unmodified for the reason that three diseases which not infrequently have aphasia as a symptom, namely, uræmia, acute hemorrhagic encephalitis, and tuberculous meningitis, are particularly liable to occur in the young. Moreover, aphasia sometimes develops in the wake of the infectious diseases, typhoid fever, diphtheria, and pertussis, and as these occur more frequently in the young, then it follows that aphasia of such origin is more common during the first years of life.

There remain to be discussed in the etiology of aphasia two of the most important organic diseases of which aphasia is a symptom. These are, tumor of the brain and cerebral apoplexy. Aphasia as a localizing symptom of new growth in the brain is one of the most important and trustworthy guides. As a rule, tumor presents the ideal lesion to cause a strictly confined destruction of one of the centres in the zone of language; at least in the beginning of the tumor. Tumors originate in the great majority of cases in one of two ways, by a proliferation of the tissue of the part and is pathological from the beginning, or by the appearance of a tissue that is foreign to the part. In the beginning the abnormality is small, perhaps microscopical. It may be confined strictly to an area that has such highly individualized function as the angular gyrus, the first temporal convolution, or to a definite part of the motor area, and

produce symptoms of almost mathematical precision. These symptoms may occur before the symptoms of brain tumor, that are so consecrated by time that they are called cardinal, develop. If the physician recognizes them and gives them proper interpretation, such perspicuity on his part may be rewarded by the life of the patient. It is not necessary to point out in detail what these various symptoms are. If one has in mind the topography of the surface of the cortical substance, and the functions allotted to it, as well as an understanding of the connecting pathways of these cortical areas, it is unnecessary to make explicit recitation of such symptoms.

Aphasia may be a prominent symptom of a recoverable form of tumor, gumma, and therefore the importance of recognizing it and employing appropriate treatment is apparent.

So frequently is aphasia an accompaniment of apoplexy, a term which is used to include rupture of a blood-vessel, obliteration of its calibre, and acute softening, that in the minds of many physicians the word aphasia suggests apoplexy. The genetic and anatomical relationship existing between the zone of language and the middle cerebral artery is well known.

Of the organic mental diseases that aphasia may be a symptom of, general paresis is the most important. In the beginning of this disease, which is pathologically a widespread degeneration of the cortex, the most prominent symptom may be aphasia. This probably coincides with beginning degeneration in some part of the zone of language. Usually the aphasia is of the sensory type.

There still remains one form of aphasia to be mentioned, and that is the form known as congenital aphasia, or congenital limitation of speech development. These cases are not very uncommon. Kussmaul described a number of instances more than a quarter of a century ago, and recently Gutzmann has studied the subject very carefully. Congenital aphasia may be partial or it may be complete. I do not include in this category lack of speech development dependent upon porencephalia or other gross lesions of the cerebral hemisphere. Aside from the disturbances in the organs of perception which are a part of idiocy, there is a not inconsiderable number of cases in which, without any disease of the peripheral percipient sensory apparatuses, or of the central sensory perceptual areas, there is a condition of speechlessness, and that, too, entirely divorced from any apparent disturbance of intelligence. It is to these cases that Coen gives the name of auditory dumbness in contradistinction to deafness and dumbness. Although these children do not present gross mental or psychical defect, usually careful examination shows that there are always a certain amount of abulia, tardiness in learning to walk, slowness in acquiring skill of any kind, and various other manifestations of psychic and somatic degeneracy. A very remarkable feature, and one that

should be borne in mind when in the presence of such cases, is that in about one-third of them there have been found naso-pharyngeal adenoid vegetations. The only other etiological factors that can be enumerated are, that this condition has been met with more frequently in males than in females, and that there is almost always a neuropathic heritage, particularly from the father's side, and that although a great many of these patients acquire considerable speech facility, it is often later in life associated with stammering.

Symptoms of Aphasia.—The most important symptomatic constituents of each variety of aphasia are herewith abbreviated from the writer's treatise, "The Genesis and Dissolution of the Faculty of Speech." The Macmillan Company, New York, 1898.

I. *Cortical motor aphasia* due to lesion of Broca's convolution (often associated with right hemiplegia). 1. Loss of spontaneous speech due to destruction of the sensory images of articulation stored up in the foot of the third frontal convolution. 2. Inability to repeat. 3. Inability to read aloud. 4. Inability to write spontaneously. 5. Difficulty in writing from dictation, in some cases amounting to complete inability. 6. Preservation of the ability to write from copy. 7. Comprehension of what is said by spoken word, but always more or less latent or manifest word blindness. 8. More or less amimia. 9. In many cases more or less echolalia and recurring utterances.

II. *Subcortical motor aphasia* (almost invariably associated with right hemiplegia). The term subcortical motor aphasia is used to indicate a partial or complete inability to externalize speech which has been properly formed in the intact speech centres which form the zone of language. The lesion is between the zone of language and the internal capsule. 1. Loss of spontaneous speech, with preservation of the memories of articulation, so that the patient can call up spontaneously the articulatory memory of the word. 2. Inability to repeat aloud, but he can repeat to himself. 3. Inability to read aloud. The patient can read to himself; he can write spontaneously, from dictation and from copy. 4. Comprehension of spoken and written language. 5. Capacity to use pantomime preserved.

I. *Sensory aphasia.*—This is the term used to designate imperfections of language, disability or inability to speak, due to interference with the reception of speech forms; that is, to lesion of the perceptive areas of the brain and the immediate incoming and commissural pathways of such areas. This variety of aphasia is not usually associated with hemiplegia. The important symptoms are: 1. Paraphasia and jargonaphasia. 2. Inability to comprehend spoken language when the auditory centre is implicated and written when the visual is the seat of lesion. 3. Inability to repeat correctly and to read aloud correctly. 4. Agraphia and paragraphia. 5. Inability to write from dictation (not complete

except in the auditory variety of sensory aphasia). 6. Inability to copy except in a mechanical way, line for line, curve for curve, and angle for angle (especially when the visual area is affected). 7. Word blindness and word deafness in varying degree of completeness, depending upon the seat of the lesion. If the lesion is of the posterior end of the inferior parietal convolution, the angular gyrus so-called, the phenomena of word blindness will predominate, while if predominantly of the posterior end of the supertemporal convolution word deafness will be the leading symptom. Homonymous hemianopsia sometimes occurs with true sensory aphasia when the lesion is of such extent or depth that it interrupts the fibres of the optic radiations.

II. *Subcortical word blindness.*—1. Word blindness always associated with right lateral homonymous hemianopsia. The patient looks at printed and at written letters and sees only black marks on a white surface; he is wholly unable to interpret them because the visual impulse is prevented from reaching the left angular gyrus. If the patient has long been habituated to writing, he may be able to gather the meaning of a written word after tracing it with the finger or a pencil. 2. Ability to spell. 3. Ability to write spontaneously and from dictation. 4. Preservation of spontaneous speech. 5. Ability to repeat. 6. Comprehension of spoken speech.

III. *Subcortical word deafness.*—1. Inability to understand spoken words. 2. Inability to repeat. 3. Inability to write from dictation. 4. Preservation of spontaneous speech. 5. Ability to read aloud. 6. Ability to write volitionally and from copy. 7. Inability to write from dictation.

Total Aphasia.—Aphasia due to lesion of the entire zone of language. The symptoms are those of motor aphasia plus sensory aphasia. Right hemiplegia is rarely lacking.

Treatment.—I shall discuss the treatment of aphasia very briefly from the standpoint of the physician and surgeon, and from the pedagogue's point of view.

Unhappily neither the physician nor the pedagogue can be of considerable assistance to the vast majority of aphasic patients. The medicinal treatment depends entirely upon the nature of the lesion that causes the aphasic symptom complex. If the lesion is a focus of encephalomalacia, then all that can be expected of medicinal treatment is to assist nature to prevent further destruction of tissue, and particularly to assist in preventing a repetition of the immediate exciting cause of the softening. On the other hand, if the lesion is a gummatous meningitis, or an isolated gummatous formation in the zone of language or the subcortical speech tracts, and these can be diagnosticated as such, medicinal treatment is of the greatest value. A case of sensory aphasia recorded by Bramwell is in evidence. This patient had the profoundest symptoms of

sensory aphasia, yet she fully recovered under the influence of antisyphilitic medication. Another case in which the results of antisyphilitic treatment were most gratifying, even though the symptoms did not completely yield to medication, has been published by Mantle. The difficulty in cases of this kind is oftenest with the etiological diagnosis. Usually the patient is not in condition to vouchsafe any information concerning himself, and as his family are, as a rule, ignorant of such matters, the physician is compelled often, if he has not been familiar with the patient's history, to make a diagnosis of previous syphilitic infection on less satisfactory data than are ordinarily considered essential. Personally I am inclined to suspect a luetic origin in every case of aphasia coming on abruptly that occurs before or during the fifth decade of life, when valvular trouble of the heart, the recent possession of acute disease, and injury can be excluded.

It would be a work of supererogation to repeat in detail the causal treatment applicable to the different forms of aphasia, for it will occur to every one who has in mind the etiology of aphasia. The treatment for aphasia in one patient may be just as different from the treatment applicable to the next one, as the causes are different. For instance, the treatment in the beginning of an uræmic attack is venesection if the patient has not an organic form of renal disease; yet this kind of treatment would be fatal to a patient whose aphasia was dependent upon autochthonic thrombosis.

When aphasic symptoms develop slowly without fever and with symptoms of increasing intracranial irritation and pressure, then tumor and abscess must be thought of. In making the diagnosis and the differentiating diagnosis one must be guided by the general rules applicable to the solution of these problems. When there are grounds for the belief that the lesion is of a luetic nature, then the administration of mercury and iodide of potassium cannot be carried out with too great promptness and attention. Syphilitic lesions that develop some years after the primary infection are, it is universally conceded, more amenable to the iodide of potassium than to all other measures combined. If, however, the date of the primary lesion is not very remote, then the administration of iodide should be simultaneous with the use of mercury, or the one should follow the other in the shape of a course of the one and then of the other.

The treatment of aphasia dependent upon organic disease, such as tumor, abscess, purulent meningitis, and focal disease of any nature, does not differ from the treatment of these conditions when aphasia is not present. When their presence is attended by symptoms which seem to indicate that they are amenable to surgical treatment, their removal should not be delayed. In fact, the aphasia is oftentimes the localizing symptom that makes diagnosis positive and operation possible. The

seemingly widespread belief that aphasia is almost exclusively an onhanger of the apoplectic state seems to necessitate emphasizing the fact that some manifestations of the complexity of symptoms constituting aphasia are of great diagnostic importance in nearly every disease affecting the brain. It is a common symptom in the recently recognized and described disease, acute hemorrhagic encephalitis; it is perhaps the most constant symptom of abscess of the brain on account of the pathogenetic relationship of disease of the middle ear to cerebral abscess, and it is not uncommon at some stage in the career of general paresis and of multiple, insular, and diffuse cerebral sclerosis, while its occurrence after injury which may cause localized inflammation of the meninges or of the brain itself, hemorrhage, depression of bone and spicules is not uncommon. Naturally, in order to produce aphasia these conditions must manifest their injuriousness on the speech centres, their interconnections, projections, or the immediate pathways leading to them; to be less specific, on the zone of language of the left hemisphere in right-handed persons, and *vice versa*. The form of aphasia that any of these diseases and accidents may cause will depend upon the location of the lesion and not on its nature. The only variety dependent upon any of the above enumerated conditions that is very uncommon is the subcortical form of motor aphasia, while the subcortical sensory variety is correspondingly frequent. This is readily understood if we recall that the part of the brain which must be diseased to cause subcortical motor aphasia is well protected from injury, and has no particular relationship to the important factors that condition abscess of the brain.

Oftentimes a careful consideration of the symptom aphasia in these diseases will be the most important factor in determining whether or not an operation shall be done, *i.e.*, whether the lesion is sufficiently localizable to warrant advising the surgeon to trepan the skull and attempt to remove the *materies morbi*.

Taking it all in all, the question of the medicinal treatment of aphasia never comes up for consideration. The question that does present is, How shall we treat the condition of which aphasia is the symptom? To answer that question satisfactorily requires an intimate knowledge of the therapeusis of all the diseases, functional and organic, that have been enumerated in the chapter on etiology, with which aphasia may be associated. Treatment may consist of such a simple matter as the interdiction of alcohol in a case of toxic dyslexia, or it may require the combined skill of the physician and surgeon to diagnosticate and remove an abscess or tumor. The treatment of the dynamic aphasias is a different matter from the treatment of the organic aphasias. In the former all that is necessary is to remove the cause and the symptom will disappear, while in the latter the cause may be removed and the pathological condition which it has excited still continues and with it the aphasia. Despite

this many of the dynamic or "functional" aphasias yield to appropriate medication for the conditions upon which they are dependent, combined with fitting treatment addressed to the mental, moral, and physical sides of the individual.

The pedagogical treatment of aphasia is a matter of recent development. It has been the legitimate result of an inquiry into the physiological and psychological antecedents of articulate speech and of clinical observations that when a young person became aphasic, even though the lesion was a very severe and extensive one, the faculty of speech was restored to him. Moreover, almost from the very beginning of the history of aphasia it has been recognized that even when the so-called "speech centre," meaning Broca's area, was completely destroyed, the patient regained occasionally some capacity to speak individual words or a number of words. Various hypotheses have been formulated to explain these occurrences, the most widely accepted apparently being that of J. Hughlings Jackson, who suggested twenty years ago that the "uneducated centre" of the opposite side is in a way related to conventional, emotional, and other forms of what he terms "degraded" speech, in contradistinction to intellectual speech. This is the theory accepted by many writers today. Recently Wyllie has framed a theory along somewhat the same lines on the "Overflow of education into the opposite hemisphere," the hemisphere that contains the zone of language takes up all that it can in the way of education, and that which it is not equal to taking up flows over into the other hemisphere. The entire subject of the repossession of the speech faculty in patients in whom it has been lost must needs be looked at to-day from another standpoint than it was a few years ago, when the forms of subcortical aphasia had not been satisfactorily differentiated. It seems to me that in the light of our present knowledge of aphasia it must be granted that not only do the corresponding areas of the opposite hemisphere sometimes under the stress of education undertake, in a very incomplete way, the speech function of the destroyed area of the hemisphere phylogenetically and ontogenetically prepared to carry on the speech faculty, but that the immediate environmental areas of the speech centres of the left hemisphere may take up the function in part. In the process of functional compensation the portion of the speech centre that is not destroyed becomes connected with the other speech centres in previously unaccustomed ways, not by the development of new commissural fibres, but through their acquisition of functional activity. Secondly, that the opposite hemisphere, the one that has the zone of language ontogenetically developed, is not an uneducated hemisphere at all, but that it is, in one sense, just as much educated as the hemisphere in which the zone of language is situated.

It must needs be admitted that there is a general auditory area, a general visual area, and a general kinæsthetic area in the right hemi-

sphere as well as in the left hemisphere, and that in-coming stimuli make a similar impression on it as they do on the socalled "educated" hemisphere. These impressions are bilateral in reception but unilateral in interpretation. This unity of interpretation is determined by commissural fibres of the corpus callosum. Now the same factors that determine right-handedness determine also that the left hemisphere shall be the executive speech side, but the elementary work is done on both sides. It seems to me that so far every one who is willing to accept the suggestions of experimental physiology must go. How many are willing to admit that the execution of speech is an automatic act and requires no conscious preparation, if process of anatomical completion is not considered "preparation," is another matter. Those who believe that the execution of speech is an automatic act, find it easier to explain how an approach to, or an unfinished automatism can be assumed by the opposite hemisphere, which is educated but which is not intended to be automatic, and especially in young children in whom the habit of automatic activity has not become fixed by continued practice. I do not think it at all improbable that if a healthy child should be kept mute until it was from five to six years of age, that is, until such a time as the neuromuscular apparatus subserving speech was fully developed, he would go through the lalling and other stages of speech imperfections that children who begin "to learn" to talk before the executive parts are fully developed do. The words that such a child used (which would, of course, depend upon the words that he had heard) might, I believe, be perfectly formed. In other words, the execution of speech would be as automatic as breathing, and that in mankind speech is more an endowment than an acquirement. Furthermore, the factors that determine the seat of this automatic activty are the conditions that we have heretofore supposed determined the education of the left hemisphere.

A most remarkable case bearing on this matter has recently been published by Bastian. The patient was a boy, twelve years old, who had been subject to epileptic fits at intervals. The first of these occurred in infancy, when the patient was about nine months old. Toward the end of the second year the fits seemed to have ceased. The hearing was good and the child appeared to be of average intelligence—to be well, in fact, in all respects except that he did not talk. When nearly five years old the little fellow had not spoken a single word, and about this time two eminent physicians were consulted in regard to his "dumbness." But before the expiration of another twelve months, on the occasion of an accident happening to a favorite toy, he suddenly exclaimed, "What a pity!" although he had never previously spoken a word. The same words could not be repeated, nor were others spoken, notwithstanding all entreaties, for a period of two weeks. Thereafter the boy progressed rapidly and

speedily, became most talkative, and spoke without the least sign of impediment or defect.

One other point that has previously been mentioned. A number of the cases that have been reported to show the assumption of speech function by the opposite hemisphere have been conclusively shown to be dependent upon a subcortical lesion and not upon destruction of a speech centre, and the partial or complete recovery of speech was commensurate with a disappearance of the conditions that had determined the partial interruption of the conducting fibres. In these cases recovery of speech has gone on *pari passu* with disappearance of other symptoms, such as hemiplegia, for instance. In other cases in which the lesion has been of the speech centres the partial repossession of speech has been due to the fact that the entire speech centre, which in the beginning of an aphasic attack was completely overthrown, has in a slight measure righted itself after the exudative and occlusive conditions have subsided. Then the patient finds himself in possession, to a very insignificant degree, of his previous speech endowment. In other cases there can be no question that the educated areas of the other hemisphere develop some executive capacity. This is determined artificially, *i.e.*, by education, and not ontogenetically as it is normally, except to the very slightest degree.

In brief, then, the education of an aphasic patient should consist in endeavoring to cause the centre or centres in the left side of the brain, that are not destroyed by the lesion which causes the aphasia, to take the initiative in the primary recall of words and complete the "circuit" necessary for internal language and speech by forcing the educated opposite side to supply a centre similar to that which has been destroyed; or, if the damaged centre is not entirely destroyed, by re-educating the cells that remain, assisting them as it were in the acquisition of a function which they were intended to perform in unison with other cells. For example, if the articulatory-kinæsthetic centre is destroyed, the primary revival of the word that should be spoken is through the auditory centre, and this calls up in temporal coincidence or succession the visual and the articulatory. The articulatory centre being destroyed, the speech impulse of the formed word cannot be completed and the kinæsthetic articulatory centre of the opposite side is acted upon through commensural fibres in just the same way as the articulatory centre of the left side was, through intercentral fibres, in the beginning. The process of education is very slow and must be given artificial aid in the way of showing the patient how to arrange the organs of articulation for the production of simple vowel and consonant sounds which he should be daily encouraged to do. After he has acquired the capacity to produce these sounds and has regained some control of the peripheral speech mechanism, he is tutored in the same way in the production and articulation of monosyllables and their combination in words. This process is a laborious one and requires great

perseverance on the part of the physician. Whenever possible the task should be entrusted to a teacher of experience. Naturally the greatest progress will be made with cases of subcortical motor aphasia because they take a more intelligent interest in the matter and because they can aid themselves by reading and writing. Most of the published cases of marked functional compensation have been cases of subcortical motor aphasia, in which ability to read has been preserved.

When the auditory centre is diseased, then the object of teaching is either to get a primary revival of the idea of words in the visual or the articulatory centre, and then throw into the circuit the component parts of the auditory that are not disorganized, or to favor the development of the auditory word centre in the opposite hemisphere. The patient must be taught to concentrate his attention on vowel sounds and then on words of one syllable, spelt letter by letter, while he tries to repeat them by the oral method. This is a very difficult matter, because in the vast majority of peoples the primary revival takes place in the auditory centre, and when this is destroyed the patient is left stranded, from a speech standpoint. The plan of education is in reality that which is used for deaf-mutes who are taught to think by the revival of verbal memories by the visual centres, the revivification of visual symbols prompted by hand or lip movements. In case of those born deaf and blind the primary revival is in the articulatory-kinæsthetic centre which, in cases like that of Laura Bridgman, is conditioned by the tactile sense. In fact, it is in all those defectives who learn to read aloud by the use of raised type.

Patients with the auditory form of sensory aphasia should be patiently taught to repeat words, the meaning of which is conveyed to them through other senses, the visual, tactual, and olfactory. It is apparent that greatest progress will be made with patients whose general intelligence is least disturbed. In subcortical word deafness the amelioration is always greater than in sensory aphasia due to destruction of the supertemporal gyrus.

The treatment of sensory aphasia conditioned by destruction of the visual centre is most unsatisfactory, and very little can be done to ameliorate the condition of such patients, even though all modes of education be assiduously employed. An effort should be made to teach the patient the recognition of forgotten symbols in connection with the arousal of other memories of them, the auditory and the articulatory. In short, the pedagogical treatment of aphasia embraces the methods of the kindergarten and the methods of instruction for those defective in one or more of the special senses. Even with their aid but little can be done, except in the subcortical varieties.

CHAPTER VIII.

THE TREATMENT OF TABES.

Tabes, tabes dorsalis, locomotor ataxia, or posterior spinal sclerosis is a disease which depends anatomically upon a primary degeneration of certain sets of sensory neurons, particularly those whose neuraxons form the posterior columns of the spinal cord and those which constitute the optic nerve. The disease is usually described as a sclerosis of the columns of Goll and Burdach; but the sclerosis is entirely secondary and is to be interpreted as the result of an effort of Nature to refill the vacancy left by the degenerated neuraxons. Although in reality not a disease of the spinal cord but a degeneration of the spinal course of the primary sensory neurons, it may be defined as a degeneration of that area of the spinal cord constituted by the sensory neurons. Clinically the disease is characterized by its more or less progressive course, by its association of sensory and motor symptoms which taken together are absolutely pathognomonic, and by its evolution in a more or less typical way.

The Causes and Lesions of Tabes.—Very little is known of the causation of tabes save that it occurs predominantly in middle adult life in those who have had syphilis. Although opinion is not unanimous in regard to the syphilitic origin of tabes, it is almost universally conceded that from sixty to ninety per cent of all tabes patients either give a history of syphilitic infection or bear unequivocal marks of its existence. The lesion of tabes is not a syphilitic one, however; in other words, the decay of the posterior columns is not secondary to deposition and contraction of connective tissue. The lesion is spoken of as a parasyphilitic one to convey the idea that it is the result of the activity of syphilis, or of some noxious agency engendered thereby after the syphilitic poison has been deprived of the power to manifest itself in inflammatory reaction. Thorough and orthodox treatment of the syphilitic infection at the time of and following its occurrence militates against, and is thought to prevent, the development of locomotor ataxia; but my own experience has been that the disease is as apt to develop in patients who have been vigorously treated for a long time as in those who have had no real antisyphilitic medication. But Fournier and others who have had large experience not only with syphilis but with parasyphilitic manifestations are decidedly opposed to this.

The disease occurs very much more frequently in males than in

females, the proportion being about 100 to 8. It is met much oftener in private than in dispensary practice, and in the intellectual and upper classes than in primitive peoples and the lower classes. It occurs oftener in the Caucasian race than in the Ethiopian and Mongolian, because the sensory neurons of the former are much more highly developed and consequently less resistant to the perniciousness of the parasyphilitic poison and exhausting experiences. Exposure to cold, frequent and prolonged fatigue, sexual excesses, intemperate use of alcohol and tobacco, poisoning by ergot and lead, the infectious diseases and trauma have been considered etiological factors ever since the disease was first described by Duchenne in 1861. They are contributory factors of some weight, but rarely, if ever, is any one of them the sole cause of the disease. The French school headed by Charcot have unswervingly contended for the importance of a neurotic predisposition and arthritic diathesis as factors in the occurrence of the disease. The significance of the arthritic diathesis, inherited and acquired, has recently been widely taught by Grasset. He believes that the lesion of locomotor ataxia is only a part of widespread disease which manifests itself by sclerotic changes, not only in the central and peripheral nervous system, but in all the visceral organs and constitutes a true visceral polysclerosis. These views may apply to the occurrence and development of tabes as seen in France, but they do not, so far as I can see, to our cases. All that can be said at the present time of the importance of heredity is that tabes may have at its foundation some defect in the development of the nervous system which in a few instances is inherited, but in the many acquired. The neuropathic diathesis is a predisposing cause. Unquestionably fatigue and leg weariness, as from long standing, forced marches, and occupations requiring exhausting use of the legs, have something to do with precipitating or perhaps starting the occurrence of tabes. Thus the disease is seen oftener in commercial travellers and in persons whose occupations require them to be on their feet a great deal than in persons of more sedentary occupations. I have seen two cases of tabes develop suddenly in men who had had syphilis, upon their change of a sedentary occupation for camp life preparatory to the late war. Although traumatism may accelerate the progress of the symptoms, it has never been proved to be the sole cause of the disease as has been urged by some. Anything that exhausts the peripheral sensory neurons and maintains the exhaustion, is a predisposing cause of tabes.

The morbid changes constituting tabes are widespread and are found in almost every part of the peripheral and central sensory neurons; but the most important lesion is decay of the sensory neurons which constitute the posterior columns of the spinal cord. This decay or sclerosis may become of such intensity before the end of the disease as to destroy every neuraxon that enters into the constitution of these

columns. If the cord is examined before the disease has existed for a long time, that part of the posterior reticular zone, known as Lissauer's column, situated at the apex of each posterior horn, and the external portion of the column of Burdach are alone affected. The later affection of the posterior internal column, or column of Goll, is to be explained in a measure by the fact that it is partly formed by the ascending fibres of Burdach's column which bend into it at different levels as the latter receive successive relays of neurons from the posterior root. In other words, the posterior columns are made up of fibres from the posterior roots. These posterior roots travel first in the exterior part of the posterior columns that grow from the spinal ganglia into the cord, and get crowded toward the median septum by the addition of new root fibres which come in from each successive level. Strictly speaking, there is no differentiation between the columns of Goll and Burdach in the lumbar region, but this is made to explain the predominance of the sclerosis in the part which corresponds to Burdach's columns, especially in the lumbar region, and the later implication of Goll's columns, especially in the upper dorsal and cervical regions. In addition to these changes, the interspinal portion of the posterior roots, especially the lumbar roots and the spinal ganglia, are the seat of profound changes; and it is highly probable that degeneration of the posterior roots is the first change. In many instances the spinal meninges, the medullary blood-vessels, the cells of Clarke's columns and the white fibres that are traceable thereto from the posterior roots, are degenerated. The other degenerations of sensory neurons are found in the peripheral nerves, the cranial nerves, especially the optic, and in the oblongata, pons, cerebellum, and cerebrum. Degeneration of the peripheral ocular neuron is not uncommon in tabes. This neuron has its cell body in the retina and its arborizations chiefly in the external geniculate body. Degeneration of these neurons causes the diseased condition of the optic nerves called simple optic atrophy. The same factors that operate perniciously upon the peripheral sensory neurons to cause lesion of the posterior columns are responsible for the decay of the peripheral ocular neurons.

Inquiry into the pathogenesis of these lesions, *i.e.*, which may be primary and which secondary, has awakened no unanimity among neuropathologists. The principal theories are: that primary sclerosis of the posterior radicular zone is the essential lesion, and that all other lesions are secondary and accessory. According to this theory, which, however, is gradually being forsaken, the disease is exclusively one of the spinal cord. A second theory, and one which merits less confidence than the first, is that the lesion of the posterior column is secondary to a meningitis which strangles the posterior roots at their entrance into the cord. Another view, which for a time was quite widely accepted, is that the degeneration in the posterior columns is secondary to a chronic sclerosis

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organs [illegible]or inco-ordination, manifesting apply t[illegible]ities, more in one leg than in the they do[illegible]es. This ataxia, most apparent present [illegible]the common name of the disease, founda[illegible]nding with apposed feet, particuin a fe[illegible]berg's phenomenon. 3. Deficient pathic [illegible]regular manifestation and shown wearin[illegible]4. Some degree of ataxia of the ing ex[illegible]ry and occasionally, ocular paror perh[illegible]or sixth cranial nerves. 5. Dimoftener[illegible]ss of the knee jerks (Westphal's them t[illegible]en the disease is fully developed, the occupat[illegible]ept in those cases in which the sclewho l[illegible]s and the posterior columns of the camp[illegible]al or high tabes. In the earlier erate [illegible]es are very much diminished or even sole ca[illegible]ed by striking the patellar tendon at haust[illegible]erforms some muscular action, such as predis[illegible]gripping one hand with the other,

The[illegible]'s phenomenon. 6. Loss of the in alm[illegible]'s remain motionless when a ray of light but th[illegible]n phenomenon. 7. Urogenital sympconsti[illegible], incontinence, impotency. 8. Irregusclero[illegible], choreiform, athetoid, and tremulous, as to [illegible]n, all rare motor accompaniments.

Those on the sensory side are: 1. Pains, sudden and short, occurring principally in the legs, but often in other parts of the body, and generally described as shooting, lightning-like, rheumatic, or electric pains. They are almost invariably present at some time during the course of the disease, but in a number of instances they are so overshadowed by graver symptoms which appear later that the patient does not lay much stress upon them. The pain is apt to occur in paroxysms, each lasting from a few seconds to a minute. It is accompanied by quivering and drawing up of the muscles of the part in which it is manifested, and often by an after sensation of soreness. In many instances the pain is for a long time the conspicuous feature of the disease. Such cases fall into a definite category, clinically: the neuralgic type. 2. Anæsthesia, delayed sensory conduction, analgesia, and paræsthesia. In some cases, especially in the beginning, certain areas of the skin in the lower extremities may be hyperæsthetic. But when the disease is developed, the rule is anæsthesia and analgesia of more or less regular distribution in four zones, the lower extremities, the brachio-mammary zone, the genito-urinary zone, and the cephalic zone (rare). 3. Diminution and loss of the deep sensibility and especially of the muscular sensibility. This hinders the patient from telling where his extremities are except by the aid of his eyes. It also accounts for the necessity of watching his feet when he tries to walk, and for the fact that when he crosses one knee over the other he lifts one leg some distance above the other. He does not glide it over easily and accurately as does one in possession of normal deep sensibility. 4. Impaired function of the bladder and bowels, which is due to anæsthesia of the mucous membrane of these organs, as well as to functional perversion of the sympathetic nerve supply and hypotonia. Incontinence of urine, difficulty in starting the stream, and inability to completely empty the bladder are in many cases initial symptoms. 5. Impotency.

The symptoms on the side of the special senses are neither so common nor so important as those already mentioned. By far the most frequent is impairment of the sense of sight due to so-called atrophy of the optic nerve. The senses of smell, taste, and hearing are occasionally encroached upon, especially the former.

The symptoms of sympathetic nervous origin are common, but not of such diagnostic importance as the motor and sensory symptoms. The principal symptoms are: 1. Gastric, vesical, laryngeal, and visceral crises, a name given to sudden, unbearable, agonizing pain occurring in these parts of the body without apparent cause and of variable duration. 2. Arthropathies, commonly known as Charcot's joint, which may affect any of the joints of the extremities. 3. Ulceration of the skin and deeper tissue, usually of the feet, but sometimes of the buccal cavity and of the hands, which shows a tendency to perforate and which is su-

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5. The general systemic treatment, and plan of treatment.

The relative importance of these modes of treatment is in the inverse order of their enumeration, but it is more logical to consider them in the above order.

Causal Therapy. The Advisibility of Antisyphilitic Treatment.—Syphilis is the only causative factor of tabes that will be considered here, as the other attributed factors will be mentioned under the general hygiene of the tabid patient. Neurologists do not agree as to the advisability of giving antisyphilitic treatment in cases of tabes. Some, like Charcot for example, steadfastly hold that such treatment is useless in every case of true tabes, no matter how clear a history of previous luetic infection the patient gives or how indifferently he may have been treated during the active period of the syphilitic poison, providing, of course, that the symptom complex of tabes did not develop within a short time after the syphilitic infection, from two to four years, when the lesion might legitimately be considered a true syphilitic and not a parasyphilitic one. On the other hand, Erb and many others who have had large experience with this disease teach that every case of tabes giving a syphilitic history should be put through a rigorous course of antisyphilitic medication, combined with general restorative treatment, if there are no apparent objections to such procedure, and providing the patient has not already received such treatment at the hands of another physician. No hard-and-fast directions can be given for the guidance of the beginner who faces this question for the first time. It is my own belief that absolutely nothing is to be expected from the administration of mercury, be it by the mouth, inunctions, or hypodermatically, in cases of genuine tabes in which no other syphilitic manifestations are present. Moreover, I believe that such treatment often does harm. On the other hand, iodide of potassium, given in small doses and for a long time, especially in conjunction with a course of alkaline waters, anti-arthritic diet, and measures that improve the nutrition and husband the energy, is one of the most valuable substances of the pharmacopœia to delay the decay of the primary sensory neuron, be it intraspinal or intramedullary. It need scarcely be said that it is of the utmost importance to adopt at once the most orthodox antisyphilitic treatment in every case of tabes in which there are true syphilitic manifestations of the skin, mucous membrane, bones, or nervous system, inflammatory or exudative. Moreover, a similar plan should be adopted in cases of tabes developing within five years after syphilitic infection; for it should not be forgotten that syphilis of the spinal cord occasionally produces a symptom complex difficult to differentiate from that of true tabes. If it is decided to put the patient upon an antisyphilitic plan of treatment, my experience has been that the best results are obtained by the use of mercury by inunction. If this method cannot be adopted, it may be given hypodermatically. I have not met the difficulty

spoken of by some writers of persuading patients to continue the hypodermatic medication because of the pain which it is said that the injections often cause. When it is decided to give the patient a course of mercury, one should enter upon it in no half-hearted way. From gr. xxx. to xc. of blue ointment should be rubbed in daily, each rubbing lasting at least from twenty to thirty minutes, and the course kept up from four to six weeks. The greatest watchfulness should be kept over the condition of the patient's alimentary tract, skin, and body weight. He cannot be kept too clean, too much in the open air, nor be too carefully fed. If one mistake more than another is made in putting a tabid patient through a course of mercury, it is that the physician is careless of the patient's loss of weight. If this cannot be controlled, the mercury should be stopped at once. After the patient has gone through the mercury treatment, he should receive a vigorous tonic plan of treatment for several months.

Treatment Directed Against the Morbid Process.—Innumerable measures have been suggested to counteract the progress of the morbid conditions forming the basis of locomotor ataxia. The majority of these have been found by experience to be nearly or quite worthless. On the original recognition of tabes by Duchenne, this clinician and many of his contemporaries waxed enthusiastic over the usefulness of the faradic current, while Remak, on the other hand, upheld the greater efficaciousness of the galvanic current. Wunderlich declared that nitrate of silver possessed greater power to check the sclerosis of the posterior column than any other medicine. His experience was corroborated in a measure by many contemporaries and followers, and to-day it is one of the most widely known and used drugs in the treatment of tabes, although in truth it is of comparatively little use. Drugs that have received far greater credit than they deserve in the treatment of this condition are ergot, belladonna, arsenic, phosphorus, gold, aluminum, and platinum. Whatever virtue they possess, apparently or actually, is due to improvement of general nutrition, the blood and its nutritive derivatives which their use for a brief period may produce, or to their symptomatic effect. The truth is that the only substances which experience has shown to have any effect in delaying the disintegration of the sensory neuron are iodide of potassium and nitrate of silver. When it is elected to give the latter, the possibility of argyria is to be kept in mind and the patient should be plainly told of the danger of discoloration. The drug may be given in pill form in one-half-grain doses two hours after meals, and kept up for a period of from six to eight weeks. The patient is then put upon iodide of potassium in from gr. vi. to x. doses, given for the same period. If there is not decided benefit from one such course of treatment, it should not be repeated. I have never seen the slightest benefit result from the administration of ergot, which,

on the recommendation of Charcot and Hammond, achieved a reputation wholly undeserved. It should never be given. Strychnine and the glycero-phosphates are extensively and deservedly used, but not with any view to influence the anatomical lesion of the disease, save by improving the general nutrition.

This part of the chapter would not be complete without a reference to serum therapy. It is well known that a few years ago Brown-Séquard startled the profesional and lay public by his claims for the rejuvenating qualities of extract of the testicle. He and his followers were able to furnish many plausible reasons, comparative and physiological, for the use of this extract and analogous ones made from the brain, the spinal cord, etc. These reasons still hold good. The utilization of the extracts, known to contain substances resembling alkaloids having indefinite physiological action, has not been attended by sufficient success to warrant one in recommending any of them in the treatment of tabes at this date.

Symptomatic Treatment.—In meeting the indications of the third caption, the physician will have abundant opportunity to display his therapeutic resources. The pressing claims are the relief of the lancinating pains. These may be so severe and so unyielding to every form of therapy that they demand the administration of opium or one of its alkaloids, but this should in every instance be kept as a last resource. Usually the pains can be ameliorated by the use of the coal-tar derivatives, such as phenacetin, antipyrin, acetanilid, exalgin, or by combinations of these with alkalies such as antifebrin and antikamnia, and by counter-irritation over the spine, such as by the actual cautery applied very lightly from the nape of the neck to the lower lumbar region, by spinal stretching and suspension, electricity, warm baths, and the application of pungent soothing medicaments to the skin. The combinations of the analgesics which I find most serviceable are:

℞ Caffein. salicylatis, ... gr. i.
Phenol. salicylatis, ... gr. xv.
Phenacetin., ... gr. x.
One powder to be given every two hours until pain is relieved.

If the pain occurs at night, and the caffeine seems to increase the wakefulness, I employ the following prescription:

℞ Phenacetin, ... gr. x.
S. Dissolve in hot water and administer conjointly with chloralamide, in powder or elixir form.

In a similar way the analgesics may be combined with sulfonal or trional. Occasionally the pain can be relieved by the prolonged warm bath (temperature 98° to 102° F.), lasting from fifteen minutes to half an hour, and general faradization of the extremities. Rarely, wrapping the legs or thighs in flannel wrung out of hot water in which capsicum

has been dissolved, or moistened with chloroform and ether, is of service. I have never seen any benefit to the pain from massage, mechanical vibration, or percussion of the nerve trunks, nor from the application of a spray of methyl chloride to the vertebral column. On the other hand, I have seen material benefit attend the application of dry cups to the spine, the use of the actual cautery, and of stretching. When all other measures fail to relieve, it becomes necessary to benumb the sensorium by the use of opium. In full knowledge of the danger that the patient is in who receives morphine for the relief of pain which is sure to return, the physician is nevertheless under moral obligation to his patient to make use of this measure in certain cases; but he who leaves a syringe with the patient or with one of the family to be used when the pain is unbearable outrages the privilege conferred on him with the Hippocratic oath. Even though the patient may live in the country far removed from his physician, no shadow of justification exists for making him a morphine habitué.

Treatment of the various crises that sometimes occur in tabes usually demands the temporary use of morphine, and the fact that the stomach is disordered in its functions in the most common of these crises makes it necessary that it be used hypodermatically. There is no danger of the formation of the morphine habit, for just as soon as the crisis is over there is no further indication for its use. If the gastric crisis is of only slight intensity, a temporizing measure of some satisfactoriness is the oxalate of cerium, given in from gr. iij. to x. doses, in the form of either a pill or wafer. Its efficacy may be materially enhanced by combining it with gr. $\frac{1}{6}$ of cocaine. During and following gastric crisis of tabes there is marked deviation of the degree of acidity of the stomach and falling off of the peptogenic properties of its secretions; and one must be guided by the condition of hyper- or hypoacidity which is present in the vomit in reaching a decision as to medication and alimentation at this time. While the crises last the patient must be fed by nutrient enemata. In gastric crises considerable relief is sometimes had by the intermittent application of ice over the stomach, spraying the epigastric region with chloride of methyl, and by touching the skin of the epigastrium with a glowing iron. Prolonged faradization of the abdominal wall has likewise seemed to me of service in a few instances. Vesical crises demand the administration of morphine to allay the overpowering distress in the beginning. After this the patient can usually be kept in a comfortable state, until the crisis ceases, by the giving of a mixture of chloral hydrate, fluid extract of belladonna, and fluid extract of hydrastis. Laryngeal crises frequently require inhalation of chloroform, but never up to the point of complete narcosis. As in other crises, the two most reliable measures are morphine and absolute quiet.

Retention and incontinence of urine frequently call for special medica-

tion and handling, aside from the direct mechanical treatment, such as regular catheterization, washing out the bladder with sterile water, or water to which some alkali or antiseptic has been added. Some preparation of belladonna or hyoscyamus with fluid extract of hydrastis canadensis or ergot may be given internally with good results. At the same time the bladder should be galvanized through the abdominal walls in the following way: One large electrode, 6 by 12 cm., should be placed above the symphysis, and the other electrode of half the size and with a concavity so that it fits up close beneath the pubic arch, then a current of from ten to twenty milliamperes allowed to flow through from three to five minutes. In some cases the mixed current, the galvano-faradic, seems to act more satisfactorily than the galvanic current alone. I have often found this expedient of considerable service both temporary and permanent. When the incontinence of urine becomes complete, it is necessary for the patient to wear a rubber urinal, and to have the bladder washed out once or twice a day.

Tabetic amaurosis is one of the saddest, and fortunately one of the more infrequent manifestations of tabes that call for individual medication in addition to that undertaken for the amelioration of the disease itself. A most astonishing occurrence, and one which cannot be explained, is that all tabetic manifestations occasionally cease when the amaurosis becomes complete. There is no measure that can be depended upon to influence the amaurosis, yet occasionally the injection of sulphate of strychnine does good, and it should in every instance be tried, beginning with gr. $\frac{1}{100}$ and increasing it every day until the physiological action is plainly manifest. Recently, the use of the double cyanide of gold and potassium has been recommended in the following solution:

℞ Cyanide of gold and potassium, ... 20 cgm.
Distilled water, ... 10 gm.

Five drops of this solution are injected into the muscles of the back once a day, and each day the dose is increased by one drop until fifteen drops are given. Then it is stopped for a few days, or is given in reducing quantities until a dose of five drops is reached. Other measures that have been recommended, such as the application of electricity directly to the eye, and mercurial inunctions, have no efficacy. Iodide of potassium should never be given in these cases, for it is unquestionable that such administration hastens the process in the optic nerves.

In the terminal stage of tabes there is great liability to the formation of bed-sores over those parts of the body that have been the seat of continual pressure, and all possible care should be taken to maintain the nutrition of the skin and subcutaneous tissue of these parts, as it is very much easier to prevent their occurrence than to cure them. Attention directed to the texture, evenness, and covering of the mattress; a daily

cleansing bath and frequent sponging with cold water and alcohol; attention to the state of the bowels and bladder, will usually prevent the occurrence of bed-sores. If they occur despite these, they must be treated according to the requirements of modern aseptic surgery.

It is not necessary to speak in detail of the treatment of such conditions as perforating ulcer, tabic arthropathy, and the osteopathies that may occur. In addition to the general treatment of tabes, they require the same surgical and orthopædic measures that trophic troubles of different origin demand. The perforating ulcer is often extremely resistant to all forms of treatment, and occasionally it progresses to such a degree and is associated with adjacent profound arthropathy that it requires amputation; but this, fortunately, is very exceptional. Hyperextension of the knees also occasionally calls for orthopædic appliances.

General Treatment.—In latter years the measures that physicians have come to rely on more and more in the treatment of tabes are those that may be included under the head of physical treatment, including hydrotherapy, balneotherapy, electrotherapy, massage, purposeful movements, suspension, and rest.

As in most other chronic diseases of the nervous system, hydrotherapy is a valuable agent in tabes to improve the patient's nutrition and to maintain his strength. The special hydric procedure that should be used in a given case depends largely on the patient, his idiosyncrasies, and his reaction to water at different degrees of temperature, but not a little on the symptomatic variety of the disease also. It is of far greater service in the cases attended by marked hypotonia than in the sensory forms. The usefulness of the warm full bath to relieve the shooting pains and the muscular soreness following an accession of the pains has already been spoken of. If given oftener than three times a week, it has a relaxing effect which should be avoided. In many cases, and especially those in which the pain is not very severe, the half-bath, temperature from 85° to 70° F., of from two to five minutes' duration, given every day, is followed by a general gain in bodily vigor, renewed feeling of well-being, and some improvement of nutrition. When it seems advisable to get cutaneous stimulation or irritation, salt, pine-needle extract, or a stream of carbon dioxide gas may be added to the water. As a rule, however, very little is gained by these procedures. The thermal element is the important factor, and to this are owing the good effects of a sojourn at many watering-places. Strong, full-blooded patients who react promptly and with pleasant subjective sensations to the application of cold water, often find much benefit from the use of water of 65° to 55° F., given from the hollow hand of an attendant, accompanied and followed by friction, and from the use of a tonic bath according to the following formula: Hot box until mild perspiration results; Charcot douche, temperature 80° F., reduced daily from two to

five degrees until 55° F. is reached, pressure ten to twenty pounds, duration thirty to sixty seconds, applied to the back, chest, abdomen, and calves, and followed by a Fleury spray, temperature 65° to 75° F., pressure fifteen to twenty pounds, duration fifteen seconds, followed by light friction, all over the body for from two to five minutes, depending on the patient's reaction, and a brisk walk in the open air.

When it is impossible to send the patient to a hydriatic institute, this procedure may be substituted by wrapping the patient in a dry, hot blanket for from ten to thirty minutes, giving him a hot drink, water, weak tea, or milk, if his digestive apparatus is in good condition; then when the cutaneous circulation, especially that of the extremities, shows the effects of this internal and external heat, water is forcibly thrown from a dipper upon the spine and over the abdomen and chest, or the patient is flagellated briskly and quickly with the ends of a towel dripping with cold water, and followed by friction.

Urogenital symptoms are often benefited by the use of cool sitz baths, temperature 75° F., duration two to five minutes. Many patients object to them because of the idea that it increases the pain, but nevertheless such a bath is often serviceable in helping to relieve the urinary incontinence. Some writers recommend for the relief of pain and for its general tonic properties the use of a cold wet pack, which, of course, becomes a warm pack after it has been in apposition with the body for a short time. It is said that the uniform warmth thus induced tends to mitigate pain and dissipate paræsthesia. I have not seen much benefit from it.

Many patients with tabes are greatly improved by a sojourn of a few weeks, four to six, once or twice a year at the thermal mineral springs of this country, and the rôle of balneotherapeutics (mineral-water treatment in contradistinction to hydrotherapeutics, the external or internal use of plain water) in the treatment of tabes is an assured and an important one. In this country the hot springs of Virginia and Richfield Springs are the most important. In Germany, those of Oeynhausen and Nauheim; and in France, those of Lamalou and Balaruc are in best repute. The manner and method of using the warm salt baths are very important, but usually it is necessary, when patients are recommended to visit a certain spring, to leave this matter to the physician of the baths. Nowadays it is almost unknown for a patient to take a course of waters at any of the springs without first putting himself in the care of one of the many physicians who are to be found there.

Tabetic patients are also often benefited, especially if they are anæmic, dyspeptic, and inclined to cachexia, by a short visit to one of the many medicinal springs in this country and in Europe, such as Poland Springs, Ragatz, St. Moritz. The regulation of diet and of exercise, the open-air existence, and the devotion of a proper number of hours to sleep, which

are the usual entailments of such places, all help to improve the patient's nutrition, to husband his energies, and to increase his strength.

The Use of Electricity in Tabes.—Almost from the time when tabes was first recognized as an individual disease, electricity has been accorded an important place in its treatment. Duchenne and Remak set the example in Europe, and they soon had innumerable followers all over the civilized world. Electricity has been praised out of all proportion to its real efficacy by some, while others seem to take a malign pleasure in denying it any virtue, either in influencing the lesion of the disease or in mitigating its symptoms. It is quite impossible to estimate accurately what service it really renders in this direction, but it seems to me that it matters not whether its usefulness is due to suggestion or to some influence that it has in counteracting the process of decay in the posterior columns of the cord, so long as it helps to prolong the days of the patient's life and to make them more livable it is deserving of employment. Electricity is utilized in tabes in the shape of the galvanic current applied directly to the spine; the galvanic and faradic currents to the peripheral parts, including the cervical sympathetic nerves, and as static electricity. Of all the procedures, galvanization of the spine is the most important. Many modes of applying it have been recommended. The two following methods are quite satisfactory: the negative pole connected with a large electrode (six inches square) is placed on the chest, and the positive pole connected with a smaller electrode (one to two inches square) on the spine, and moved slowly from the cervical to the sacral region, while a current of from six to ten milliamperes is allowed to flow, the duration of the treatment being about ten minutes. This should be done daily, and in very few cases it is more satisfactory if the electricity is applied twice a day, each séance being of from five to ten minutes' duration. It is highly probable that the beneficial effect of electricity thus applied is commensurate improvement of the circulation of blood and lymph through the posterior columns, nerve roots, and adjacent tissue. The other method is to place the cathode firmly over the superior cervical ganglion at the angle of the lower jaw, the anode over the opposite side of the spinal column, close to the spinous processes, and allow a current of four milliamperes to pass. The positive pole is then rubbed up and down the spine for about five minutes on one side, then the cathode is changed to the cervical ganglion of the other side, and the same procedure used for the opposite half of the spinal column. In this way, the posterior roots and the intervertebral ganglia are stimulated, and in view of the important part taken by disease of these structures in the pathogenesis of tabes, it can readily be seen that this is a desirable operation.

Some amelioration of the paræsthesia may confidently be expected from the use of faradic electricity applied to the skin of the extremities. Greatest excitation of the cutaneous nerves is obtained by using the small brush

electrode. If it is desired to stimulate the peripheral neuromuscular apparatus, either the faradic or the galvanic current may be employed. When it is elected to use the latter, the positive pole should be used as the differentiating electrode. I have seen some benefit follow the use of static electricity, applied by means of a large brass ball electrode or by a roller. Numerous theories have been suggested to explain this beneficial action, but its use is based entirely upon empiricism. Some maintain that the sensory nerves conduct the electric energy along their course to the cord, and the current thus exercises a beneficial action upon the entire sensory neuron. More plausible is the explanation that the sharp muscular contraction caused by the spark improves the neuromuscular tone. It need scarcely be said that electrical treatment should not be relied upon exclusively. On the contrary, it should be looked upon as an adjuvant of some importance, and given in connection with other physical and medicinal treatment. No more is it advisable to give electricity month after month without interruption. Its effects seem to be best when it is given for a period of six weeks three or four times a year.

In certain cases of tabes the regular, persistent use of massage does a great deal of good. At least it gives more comfort than almost any other measure. It is especially useful in cases of long duration. It counteracts muscular hypotonia and asthenia in a more gratifying way than any other measure, and I have often seen the symptom described as "giving way of the knees" entirely disappear under this form of treatment. Women tolerate massage and benefit from it far more than men, and this rule holds good for tabes. The most useful massage procedure is stroking. Diligently and carefully used to the muscles of the back it overcomes the dorso-lumbar hyperæsthesia, and applied to the extremities it not infrequently assuages the pain and mitigates the hypotonia. Vigorous kneading and compression of the back often decrease the girdle sensation, while general massage may be used for its tonic effects. Stretching of the peripheral nerves either by operation or by the bloodless method, which formerly had considerable vogue, is to be severely frowned at. No doubt such procedure sometimes relieves pain, but the same results can be obtained by having the patient lie on the back with the head slightly elevated and the legs extended; an attendant then grasps the feet and draws them back toward the patient's head, the knees remaining extended. This position is maintained for from two to four minutes, and repeated once or twice a day.

Suspension a Therapeutic Agent of Some Value.—Suspension seems to have been first recommended by Motschutkowsky in 1883. In the decade following, neurologists of every nationality testified to its efficacy in ameliorating the symptoms of tabes, and apparently in modifying the course of the disease. During the past few years very little has been heard of it. Nevertheless it is still in use, and a dispassion-

ate estimate of its value based on experience would probably hold that its methodical use is attended by a lessening of the severity and frequency of the pain, by an improvement in walking, by some amelioration of the vesical symptoms, and by an improvement in the patient's general morale. The contraindications for suspension are cardiovascular lesions, pulmonary tuberculosis, emphysema, apoplectic and epileptic attacks, a tendency to syncope, and obesity. It should never be used in the paralytic stage of tabes. The patient may be suspended in the Sayre apparatus, but the most expedient way is to suspend him from the head and elbows while seated by means of a specially constructed harness which hangs from one end of a horizontal beam that is movable pivotally on a firm perpendicular. Weights are attached to the other end of the horizontal beam and by increasing or decreasing the number of weights the desired degree of suspension force can be had. Its *modus operandi* is not very clear, but it probably acts mechanically to stretch the spinal column and its attachments, and thus indirectly to improve the circulation in the spinal vessels.

Re-education of the Ataxic Extremities, Fraenkel's Method.—Difficulty of locomotion eventually becomes the most conspicuous burden of the patient's life. So long as he is able to get about unaided he may live not only a useful, but comparatively an enjoyable life; but when he has to rely upon the arm of an attendant, a pair of crutches, or a wheel chair fortitude deserts him, and with it hope and usefulness.

Of all the measures that can be utilized to counteract the development of ataxia, and to overcome it after it has developed, the plan suggested by Mortimer Granville of England in 1881, but formulated and introduced to the profession by Fraenkel, of Heiden, in 1890, and since then very much elaborated by himself and others, is the most important. The essential feature of the plan is to submit those muscles which manifest the inco-ordination to a series of graduated and systematic exercises. Each movement thus performed will be accompanied by kinæsthetic sensations and memories in the corresponding areas of the brain. Fraenkel has therefore referred to the treatment as one of cerebral gymnastics, and in no way to be confounded with gymnastics of force. The underlying principle is that if the patient is made to overcome the ataxia by the performance of simple movements with purposeful intent and attention, his sensori-motor cortex will become so re-educated that it will direct the movements without attention and conscious volition.

Fraenkel's procedure consists essentially in the exact and methodical execution of purposeful movements which require skill and not force. In the beginning these movements should be very simple, and gradually made more complicated as the patient becomes capable of performing them. They should not be done in a perfunctory way as are ordinary gynmastics, but with the attention closely concentrated on every movement.

The benefit which follows the use of the exercises is often most en-

couraging to the patient and gratifying to the physician, especially when used as an adjuvant to the general tonic and supportive treatment already spoken of. Naturally they are of signal service in those cases in which the ataxia is not extreme. Oftentimes, however, patients who are dependent upon crutches may be so benefited by this treatment that they can walk unaided, particularly if the hypotonia is not profound. It must not, however, be forgotten that these exercises have no influence on the course of the disease, and that they benefit only one of the numerous clinical manifestations, namely, the ataxia.

The cases of tabes that seem to be most favorable to the employment of Fraenkel's treatment are those in which the ataxia appears very early in the disease; those in which it is of comparatively slow development; and those in which the inco-ordination manifests some tendency toward spontaneous amelioration. The employment of this method of treatment is contraindicated in weak anæmic patients and in those who suffer more or less constantly with pains or crises; in cases of acute and subacute tabes, that is, in cases of sudden onset and in which the habitual manifestations of the pre-ataxic period succeed each other rapidly; in patients with tabid optic atrophy, fragile bones and those who have had what is generally called spontaneous fracture or rupture of tendons. When any cardiopathy or aneurism exists, the method must be tried very tentatively, if at all. It is not applicable to very obese or arthritic patients, and finally it is absolutely contraindicated when there are great laxity of the ligaments and severe arthropathy.

The formula for these exercises of skill which was given by Fraenkel in his communication to the Moscow Congress in 1897 seems rather formidable. The following *résumé* will aim to give the more important essentials. The illustrations are taken from Goldscheider's excellent brochure on the subject. The physician who undertakes to employ the exercises must needs remember that they demand for their successful utilization a great deal of time and more patience; but expenditure of these will be rewarded. Whenever it is possible the exercises should be entrusted to a trained attendant under the observation of the physician. They should be practised several times a day for a few minutes at a time, but never to the point of producing considerable fatigue. When they cause great fatigue they should be done principally in the morning or after a long rest.

Ataxia of the lower extremities is commoner and always more severe than of the upper; it is also more difficult to overcome by the Fraenkel movements because of the associated disorder of equilibrium, which is often so profound. To overcome the ataxia of the legs the patient should begin by making simple, primitive movements that can be executed while lying in bed. For instance, lying on the back with the legs uncovered, he should be required to go through movements of flexion, extension,

abduction, and adduction of the different joints of the lower extremities, slowly and deliberately and with all the accuracy that can be commanded, first with one leg, then with the other, and finally with both legs simultaneously. Fig. 15 illustrates one of the simplest and most important of these movements. It is spoken of as the "fourfold

FIG. 15.

movement exercise." It consists in raising of the outstretched leg, flexion of the thigh and then the knee to make a double right angle, then extending the leg and finally lowering it. It will be found that these simple exercises are very fatiguing, not so much because of the muscular exertion but because of the attention that they demand. They should be persisted in, however, until the patient can execute them easily, accurately, and without much effort. Another very important series of exercises is represented by Fig. 16. As seen from the illustration it

FIG. 16.

consists of a short step ladder fixed at the bottom of the bed on which the patient is required to make accurate stepping and climbing movements. Similar movements of precision should then be practised by the patient while sitting. It is unnecessary to detail the great number of modifications of such movements that can be devised. Care and precision in their execution are most important. These primitive movements

are absolutely essential and should not be neglected even by those whose ataxia is not so great as to prevent them from walking.

The patient should then practise rising deliberately from the sitting position with or without aid, as the condition of his strength and equilibrium demand, and then sitting slowly. As soon as possible he should do this without assistance or support. He should then practise standing upright alone or with support or assistance, with the feet put firmly beneath him, aided at first by the hand or eye, then as he gradually acquires confidence and skill, without the aid of either and with the feet close together. The physician can be of great service by assuring the patient of his capacity to do this, for much of the disequilibrium is the result of fear and lack of confidence. When he has succeeded in learning to stand alone or with the aid of a stick, he should begin movements of bending

FIG. 17.

FIG. 18.

forward as far as possible, then slowly raising himself to a vertical position, bending first one knee and then the other, adopting the squatting position and then rising from it, and various others.

After this, movements of the lower extremities looking toward walking are to be practised. The patient should stand with the aid of crutches or a stick and endeavor to put one foot forward slowly, deliberately, and accurately upon a certain marked spot, from twelve to sixteen inches in front of him. This should be done five times in succession with all possible precision and accuracy, while the patient or the attendant counts. Then the same procedure is to be repeated with the other foot. After the patient has acquired facility in doing this he should try to walk with the aid of sticks or an attendant, taking each step slowly and with the greatest deliberateness, ten steps forward, then ten steps backward. The patient should also be required to practise walking movements of the feet while sitting. This should be done first with one foot, then with both feet simultaneously, as shown by the accompanying illustration (Fig. 17). Another exercise of considerable service is illustrated by the simple

apparatus (Fig. 18). The patient first touches all the round-top shorter uprights and then all the flat-top taller uprights in succession. Of course, when the patient cannot stand or walk even with the aid of a stick or an

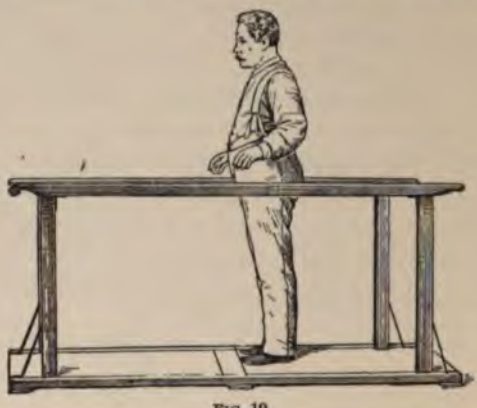

FIG. 19.

assistant, it is necessary to provide him with some such apparatus as shown in Fig. 19, by which he can support himself while practising the many different exercises of skill. The exercises that can be devised with such a contrivance are almost innumerable. A few of the important ones are illustrated by Figs. 20 and 21.

By assiduous practice of these exercises the patient will soon be able to walk without holding an immovable support. It then remains for him

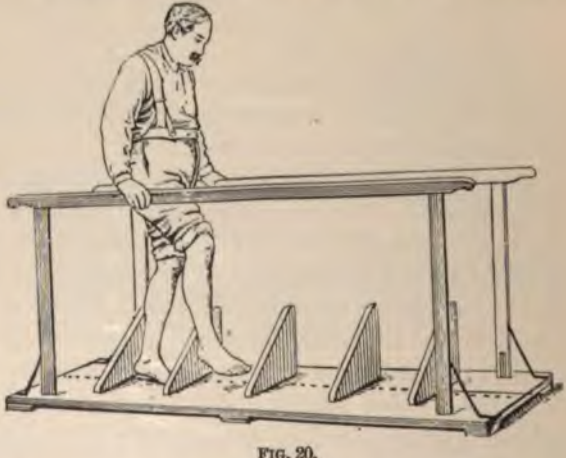

FIG. 20.

to practise walking in a straight line; to trace figures or lines with the toes and to indulge in other movements of the lower extremities that require accuracy and skill for their execution.

To overcome the ataxia of the upper extremities one proceeds in a

similar fashion. The patient is made to execute simple movements at first, followed by more complicated ones with the fingers, hands, and forearms. When the patient can use his muscles without difficulty for these movements, he should be given exercises which require more skill and patience for their performance. Fraenkel has devised for this purpose a number of apparatuses. One of these consists of a piece of wood having the form of a triangular prism forty centimetres long, each side measuring five centimetres. This piece of wood rests on one of its sides. The upper edge is grooved out, one of the others is smoothed off, while the third is sharp. This apparatus is placed before the patient, who holds in one hand a large pencil and he endeavors to put the point of the pencil in the groove and move it back and forth therein

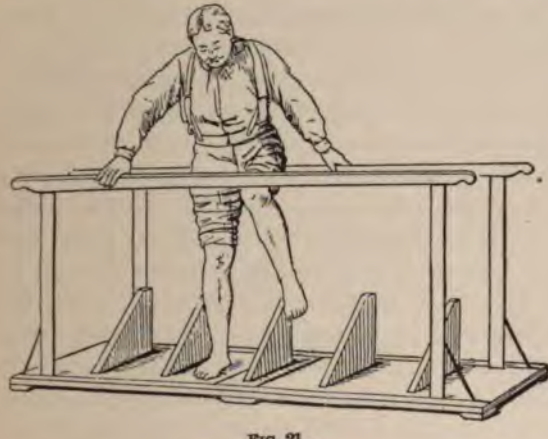

FIG. 21.

steadily and accurately from the farthest to the nearest end, keeping the fingers and the wrist immovable. At first the patient has considerable difficulty in keeping the point of the pencil in the groove, but after repeated exercises he is able to do so. He should then practise retracing with a pencil simple designs consisting of straight, zigzag, and curved lines. If the tracings of these figures are kept, it enables one to follow the progress that the patient makes toward acquiring co-ordination. Another apparatus consists of a piece of board in which depressions have been hollowed out at regular intervals, into which the end of the finger can be placed. These holes are numbered. The board is placed before the patient, who holds the right arm raised and the index finger extended. He then puts the end of the finger into the depression rapidly and as accurately as possible when the attendant calls out the number. At first he is made to repeat the same number until he can do it with considerable accuracy. This exercise can be made more complicated by having the patient put marbles in the holes as fast as the number of the holes is

called out. This simple device may be replaced by a board filled with holes, in which the patient is required to place a number of pegs, such as a cribbage board.

The great number of variations that can be devised by any one, even the patient himself, will suggest themselves at once to the physician. After the patient has acquired skill in these exercises he can practise with a contrivance consisting of a series of balls of different sizes suspended by threads from a horizontal bar. One of these balls, commencing with the largest, is made to oscillate, and while it is oscillating the patient is told to seize it and bring it to a state of rest. At first he is left free to choose the moment at which to seize the ball, but later he is required to do so at a moment determined by its oscillatory excursion. This exercise is repeated with all the different balls. The smaller the ball the more difficult the exercise.

Plan of Treatment.—The importance of a plan of treatment for patients with locomotor ataxia can scarcely be overestimated. The medicinal treatment is of little consequence compared with hygienic, dietetic, physical, and disciplinary measures. The amelioration of the patient's symptoms and the degree to which comfort and longevity can be given him stand in direct relation to the promptitude with which the diagnosis is made and proper treatment instituted. Every patient who consults a physician for ailment of any kind, aside from the acute infectious diseases, and who gives a history of syphilis, should be carefully put through the tests requisite to reveal the existence of tabes. The necessity of this statement is impressed upon me by the fact that out of one hundred patients which I have personally studied seventy-one had at one time been diagnosticated as, or treated for rheumatism. It is scarcely necessary to emphasize how essential it is closely to scrutinize the patient who comes complaining of pains, vesical shortcomings, altered genesic instincts and capacity, or any of the symptoms of the general neurasthenic condition. At such an early date it may be quite impossible to satisfy one's self of the reality of the existence of tabes. Nevertheless, the patient may without any other consequences than benefit be put under a treatment for tabes while careful watch is kept for more diagnostic corroborative symptoms.

When the existence of the disease is unmistakable, the question must always be decided whether or not to inform the patient. Naturally no general rule can be given, but it is my own belief that nothing whatever is to be gained by concealing from the patient the nature of his disease, for fear that such knowledge may have an injuriously depressing effect if he has heard of the disastrous outcome of the disease in others. If the first physician whom the patient consults does not apprise him or one of the family, which is tantamount to telling the patient himself, of the nature of his disease, it is very likely that sooner or later he will consult

another physician who sees his way clear to impart such information. The first physician will then be held to have made a mistake and to have wasted time in treatment which might have been beneficially employed if the exact nature of the disease had been known. It is not wise in the majority of cases to make an unmodified diagnosis of locomotor ataxia in the beginning; nevertheless the patient should be made to understand that his disease is serious, and in order that it may not disable him, it is necessary to adopt a vigorous plan of treatment for the purpose of stopping the progress of the disease. The important lesson for him to learn is that a long period of usefulness and comparative health waits on methodical and continued treatment. Occasional and desultory visits to a physician which are rewarded by one or two prescriptions, are tantamount to no treatment at all.

After getting *en rapport* with the patient and securing at least a degree of his confidence, it is necessary to decide whether or not he shall forego his customary occupation, providing of course his position in life allows him to do so. Individual factors in each case must influence this decision. As a rule, unless special indications exist to the contrary, such as the neurasthenic state, manifestations of syphilis in the blood-vessels, slight but progressive emaciation, and unless the occupation is one that is conducive to leg weariness and entails worry and care, it is best to let the patient keep to business at least to a certain extent. His infirmity prevents him from indulging in many of the pleasures and occupations which help to pass the time. And to take a man accustomed during all the years of his life to engrossing occupation and throw him at once into enforced idleness, at the same time restricting him from many pleasures which are harmless to the healthy individual, is tantamount to converting him at once into an introspective, depressed, miserable being. On the other hand, if he is allowed to pass a portion of his time in business, while the rest is given over to measures that may be legitimately called treatment, such as moderate bicycling, golfing, driving, and not to speak of the time required for hydriatics, electricity, massage, and rest, he will have little time to think of himself. A rule that admits of few exceptions in handling a case of tabes is that sanatorium treatment is not advisable, at least not until the last stages of the disease.

Tabetics do not tolerate brusk changes of temperature or oscillations of atmospheric pressure. Such changes are apt to be accompanied or followed by attacks of pain, gastric crises, exaggeration of ataxia, and general asthenia. A temperate climate and a moderately dry atmosphere are most favorable for patients with this disease.

In regard to the patient's diet, it may be said that tea, coffee, alcoholic stimulants, and tobacco should be used most temperately or entirely eschewed. It is poor judgment to insist that a man who has taken

these dietetic luxuries in moderation and to his apparent benefit for many years, shall give them over entirely just because certain nerve fibres are beginning to decay. A mixed diet with a preponderance of vegetables and fats, if the patient can take them, is the nearest approach to the ideal. As in all nervous diseases, functional or organic, the patient should be fed frequently, five times a day at least. The supplementary meals should consist of milk or other food, the taking of which requires no effort on the part of the patient. The tabid patient who spends twelve out of the twenty-four hours in bed is more just to himself than he who encroaches upon this number. In regard to exercise, very little can be said in a formal way. Leg weariness is to be avoided at all hazards. It will be found that the varieties of exercise and sport that are in vogue in any country or section of the country for the average healthy man can be indulged in quite as well by the tabid patient, providing he is not inclined to be intemperate. It is unnecessary to speak of the importance of avoiding injurious indulgences of all kinds, but patients in the early stages of tabes often seek advice concerning attempts at sexual intercourse, for in many instances sexual potency is not entirely lost until the disease is quite advanced. So far as possible cohabitation should be avoided, although if there is no pathological excitation no harm can result from occasional indulgence. The general hygiene, including clothing, cleansing baths, regulation of bowels, maintenance of the integrity of digestion, do not require specific mention. As in all other nervous diseases attention to these details is rewarded by an accession of the patient's nutrition and increase of physical strength.

The use of drugs to maintain nutrition constitutes an important part of the treatment of tabes. Of the general tonics and restoratives iron, arsenic, and quinine are by far the most important, while the simple bitters and dilute hydrochloric acid are to be used for their direct effects on the appetite and digestion. There would seem to be a fixed conviction on the part of many practitioners that strychnine is a drug of surpassing value in all diseases of the spinal cord. In reality it is not, and in tabes its unguarded use may be followed by increase of the lightning pains and irritation in the urogenital sphere. A few years ago I gave it a thorough trial in ten cases of tabes, most of the patients being in the end of the second and beginning of the third stage and hospitalized. It was given hypodermatically, beginning with one-sixtieth of a grain and gradually increased to one-eighth of a grain *per diem*. Its proclivity to cause pain was guarded by the simultaneous use of small doses of morphine. No discernible benefit followed its use. It may be used as a tonic, but specific effect should not be anticipated from it.

Briefly to summarize the treatment of tabes, it may be said that it consists of: 1. The determination whether antisyphilitic treatment shall be undertaken. 2. The utilization of electricity, hydrotherapy, massage,

and counter-irritation. 3. The education of the ataxic members, the rehabilitation of purposeful movements. 4. The administration of iodide of potassium in tonic doses, nitrate of silver, and restoratives. 5. The relief of individual symptoms, such as pain, crises, dereliction of the function of the bladder, ocular palsies, amaurosis, and trophic disturbances. 6. The adoption of a plan of treatment and carrying it through. This may be construed as psychical treatment if one so desires. However that may be, no one who has had experience in treating locomotor ataxia will be likely to deny its importance.

CHAPTER IX.

THE TREATMENT OF THE HEREDITARY ATAXIAS.

1. Hereditary Spinal Ataxia.

Hereditary spinal ataxia, Friedreich's disease, is a degeneration or lack of development of the peripheral sensory neuron and the central motor neuron in their spinal course, constituting posterior and lateral sclerosis of the cord. It is a rare disease of childhood, very chronic in its course, and unamenable to every form of therapy. The three important etiological factors of the disease are: the family history, the age when the symptoms first occur, and the relationship of acute disease. The name hereditary spinal ataxia is misleading, because in at least one-third of the cases there is no evidence whatever of immediate or remote heritage of the disease, and in upward of ten per cent of the cases there is no history of pathological heritage of any kind.

The most striking fact in the etiology is the occurrence of the disease in more than one member of the family, though even this is not discernible in all cases. It is more apt to occur in large than in small families, and at times it seems to affect the male members while the females escape, and *vice versa*. Although all the members of a family are not affected, unless in exceptional instances in which the number is very small, the remaining members may show some other form of degenerative nervous disease, and possibly nervous disease of a teratological nature. The immediate and remote family history may show the existence of some degenerative neurosis or psychosis, such as epilepsy, hysteria, inebriety, and migraine. The disease develops as a rule between the ages of five and fifteen; it sometimes occurs in a recognizable form before that period, and the number of cases that develop after the fifteenth year is not very great. It has often been noted that when the disease occurs in several members of the same family, it appears in the first patient within late childhood or early maturity, while in each succeeding patient it appears at a less advanced age. The factors that apparently have something to do with exciting the disease, at least to such activity that it becomes recognizable, are the infectious diseases—naturally those common to childhood—and injuries. The influence which these factors have may be interpreted in two ways. The acute infectious diseases may have nothing whatever to do with causing the disease except so far as they weaken

the neuromuscular system and keep the patient in bed, during which time complete co-ordinated movements, such as walking, running, and climbing, which the person may have but recently mastered, are partially forgotten. Either of these factors, or both combined, may be sufficient to make noticeable the most striking feature of the disease, viz., inco-ordination, which had existed before the infection. On the other hand, infectious processes and their products may act injuriously upon neurons robbed by heritage of their complementary development and cause them to degenerate. This latter belief I hold to be extremely improbable. A number of cases have been reported during the last few years in which the disease was ushered in by febrility. What the genesis of this fever is has not been suggested, but it seems to me that the explanation of its injuriousness is the same as that offered for the infectious diseases. A number of other etiological factors of comparatively insignificant importance are the occurrence of the disease more frequently in males than in females, oftener among the poor than among the rich, and the recording of no case in other races than the white. These facts, with the exception of the last named, are in entire accord with the teachings of other familiary and hereditary diseases, all of which show themselves more frequently in males and in people of the lower walks of life. The disease is met with in the poor and unenlightened, because parental consanguinity, excessive fœtation, and malnutrition are commoner.

The distinguishing clinical features of Friedreich's disease are six in number: (1) Ataxia in all purposeful movements and station; inco-ordination due to loss of the sense of equilibrium, and irregular involuntary movements necessitated by continual attempt to maintain equilibrium. (2) Loss of the tendon jerks; diminished myotatic irritability and muscular weakness, which may amount to paresis of the lower extremities. (3) Deformities of the spine, usually scoliosis, lateral curvature, and some deformity of the feet, commonly pes cavus. (4) Nystagmus, static and dynamic. (5) Disturbance of articulation and intonation. (6) Features that distinguish it from tabes or locomotor ataxia; absence of lancinating pains, intactness of sensibility, normal pupillary reactions, no disturbance of vision, and non-involvement of the urogenital sphere.

The treatment of hereditary spinal ataxia consists in providing the patient with an intelligent attendant or nurse who will practise and instruct him in the system of purposeful gymnastics, known as Fraenkel's movements. This system of systematic exercises for training the ataxic limbs is described in the chapter on the treatment of tabes dorsalis. These, with measures taken to maintain the strength and nutrition of the patient, are all that can be offered in the shape of therapy. It is not probable, even if we could treat the patient from the very beginning of the disease, that medicines, such as silver, aluminum, and iodide of potas-

sium, which sometimes have a beneficial effect to prevent the rapidity of development of certain spinal-cord degenerations, such as tabes, would be of any service in this disease. The spinal curvature rarely calls for direct treatment, but some patients are more comfortable when they wear a light wooden or plaster jacket. Parents to whom are born one or more children who afterward manifest a disease of this kind should be implored to surcease procreation. If they do not, the endeavor should be made to avoid the factors that seem at times to act as exciting causes—the infectious diseases and injuries.

2. Hereditary Cerebellar Ataxia.

The name hereditary cerebellar ataxia is given to a complex of symptoms occurring generally in the later years of childhood and early adult life, consisting principally of ataxia of a cerebellar character, exaggerated knee jerks, hesitating, abrupt, explosive speech, and mental shortcomings. The name was given to it by Marie, not only because of its conformity with the name of the disease which it resembles, hereditary spinal ataxia, but because it indicated the most important symptom of the disease as well as its hereditary nature. The course of the disease is a progressive one.

The etiology of hereditary cerebellar ataxia is very obscure. The meagre statistics that are obtainable show that the familiary and hereditary features are much more constant than in hereditary spinal ataxia, but it is possible that further observation will show that neither of these features is absolutely essential. The familiary element is often easily made out, while the hereditary element is much more uncommon. The disease first shows itself as a rule at a more advanced stage than does Friedreich's disease, although cases occurring earlier in life have been recorded. Males are afflicted oftener than females. In short, the social and sex relations are similar to those of Friedreich's ataxia, and the same may be said of accidental factors, such as the occurrence of infectious diseases, blows, falls, frights, exposure, all of which have been noted more than once by different observers. If the disease is a protal one, that is, one that posits for its occurrence a lack of connate development in the constituents of the cerebellum, as I believe it is, then none of these factors can have any material influence in causing the disease, although they may bring into earlier prominence symptoms that would otherwise be delayed.

The distinguishing features of hereditary cerebellar ataxia are: (1) uncertain, reeling, inebrious gait; occasionally slightly spastic. The patient walks with the feet wide apart, body bent forward, head thrown backward, chin elevated, and does not watch the feet. (2) The ataxia is very much less or disappears when the patient is lying down, but in-

co-ordination can always be demonstrated even when in this position. (3) Overaction of the mimetic muscles when speaking or in emotional display. (4) Hesitating, abrupt, explosive, ataxic, defective speech. (5) Easily elicitable, often exaggerated knee jerks; occasional ankle clonus. (6) Slight irregular twitchings of the eyeballs, but no true nystagmus. Deficiency of action of the external recti. (7) Mental impairment, varying from slight stupidity to complete dementia.

The treatment of the disease does not differ from that of hereditary spinal ataxia, although the patient requires much greater attention on account of the greater difficulty in locomotion and co-ordination. The greatest care should be used in differentiating the disease from disseminated insular sclerosis because the prognosis regarding life is much less serious in the latter disease.

3. Hereditary Ataxic Paraplegia.

Hereditary ataxic paraplegia is a primary degeneration or lack of development of the lateral columns of the cord which occurs in children soon before or about the time of puberty, and is characterized by ataxia, principally of the lower extremities, but also of the upper; paraplegia of a more or less spastic nature, and some cutaneous anæsthesia. In some cases the disease seems to be of sudden development, but this may be more apparent than real. It likewise occasionally seems to follow in the wake of the infectious diseases, but what has been said concerning the relationship of infectious diseases to the other hereditary degenerative disorders of the spinal cord should be borne in mind. The principal symptoms are: 1. Weakness of the legs associated with ataxia. 2. Exaggeration of the tendon jerks of the lower extremities. 3. Extension of the big toe on plantar irritation (Babinski phenomenon). 4. Integrity of the urogenital sphere. 5. Mental intactness. The disease often pursues a more or less progressive and rapid course, and terminates fatally in from two to four years. Occasionally the course of the disease is extremely slow.

The treatment of this disease is not unlike that of the other hereditary diseases of the spinal cord. The most insistent measures are directed to the care of the bladder, bowels, and skin. The general nutrition of the patient must be maintained, and his or her comfort contributed to by the use of orthopædic and supporting apparatus. Aside from this, the treatment is entirely symptomatic.

CHAPTER X.

THE TREATMENT OF SYRINGOMYELIA.

SYRINGOMYELIA is a disease of the spinal cord and oblongata, characterized clinically by an association of motor, sensory, and sympathetic symptoms, closely simulating tabes plus progressive muscular atrophy, and anatomically dependent upon cavity or fissure formation predominantly of the gray matter. The cavity or fissure of the cord may be single or multiple. It varies in diameter from a mere slit to an opening sufficiently large to admit the end of the little finger. Longitudinally it may extend throughout the greater part of the spinal cord, but it is more often confined to one or a few segments. The hole or slit or fissure or whatever it may be does not preserve the same shape throughout its entire course, nor does it occupy relatively the same position in different segments. The cervical cord is most commonly the seat of cavity formation, and after this the upper cervical region with the lower third of the oblongata. The lumbar segments are the next most common seat while the dorsal segments are rarely involved—that is, by a cavity that confines itself to these segments, it being borne in mind that it is not at all uncommon to find holes in the dorsal cord in connection with cervical or lumbar cavities. When the syringomyelia is of the cervical segments, the gray matter is usually rather uniformly encroached upon, while when the cavity formation is of the lower dorsal and lumbar region, the posterior horns and posterior columns are oftener involved and there is relatively less encroachment upon the anterior gray matter. A very curious fact is that the anterior cornua never seem to be exclusively affected, nor are the anterolateral columns, although the corresponding parts of the posterior half of the spinal cord are frequently exclusively affected. The area of special predilection of cavity formation in the oblongata is the ascending root of the trigeminal nerve and the vago-glossopharyngeal-hypoglossal nucleus.

Syringomyelia is by no means a pathological entity. The cavity may be a congenital condition existing in the shape of an enlarged central canal. In some such instances the possessor goes through life without any apparent evidences of its existence. Such a condition must, however, be a locus of diminished resistance wherein inflammatory or degenerative changes may begin. The hole in the cord constituting syringomyelia may be due to a gliomatosis resulting in the formation of a

glioma which has predominantly longitudinal extent, or it may be caused by a proliferation of glia tissue and consequent destruction of the parenchyma, that is, the condition known as gliosis. It would seem to be definitely proven that cavity formation may be the result of hemorrhage into the substance of the cord, which, acting by cleavage in the direction of least resistance, causes the formation of an empty space after the coagulum has been partially or completely absorbed. Syringomyelia has been found associated with chronic pachy- and leptomeningitis, with chronic myelitis, especially with the form known clinically as lateral sclerosis, and with other organic diseases. Just what relationship these morbid conditions have to the syringomyelia has not been determined. Occasionally it has been found coexistent with hydrocephalus, atrophy of the brain, cerebrum and cerebellum, and with congenital conditions, such as spina bifida.

Very little is known of the etiology of the disease. Although of recent recognition, its occurrence is by no means very uncommon. Men are afflicted more often than women. A neuropathic history is the rule, and the disease has been encountered in several members of the same family. It is associated sometimes with such functional nervous diseases as exophthalmic goitre, hysteria, chorea, neurasthenia, and Raynaud's disease, but it is highly probable that these conditions are merely expressions of an encroachment by the cavity formation upon the sympathetic nervous system representation in the spinal cord. The most important attributed exciting factors are trauma and the infectious diseases. Just how these act, except to favor the occurrence of gliosis or gliomatosis and hemorrhage into the substance of the cord, it is impossible to say. Some authors have laid particular stress upon dystocia as an exciting cause. But it must be extremely uncommon, and when it has any influence it is through producing rupture of intramedullary blood-vessels. The infectious diseases, such as typhoid fever, pneumonia, and malaria, may likewise act to produce degenerative changes in the blood-vessels, which predispose to intramedullary hemorrhage and thus to cavity formation. Syphilis plays no rôle in the etiology of the disease, although syringomyelia occasionally occurs in syphilitic patients. The endeavor has been made by some physicians to establish the nosological identity of syringomyelia and anæsthetic leprosy, but very little success has attended such efforts.

Symptoms.—The typical symptom complex of syringomyelia is progressive atrophy of individual muscles or groups of muscles, associated with a widespread partial sensory paralysis, manifesting itself as analgesia and thermoanæsthesia, with fully preserved tactile sensibility, and with trophic manifestations especially of the skin and of the bones. The seat of the atrophy will depend naturally upon the location of the cavity in the cord. Usually it is of the upper extremities and face. If the cavity is in the lumbar region, the atrophy will be of the lower ex-

tremity. The muscular atrophy is dependent upon a destruction of the ganglion cells of the peripheral motor neurons. When the cells constituting the common origin of the vagus, glossopharyngeal, and hypoglossal nerves in the oblongata are encroached upon, there will be muscular atrophy and other disorder indicative of the partial or complete destruction of these cells. The motor and sensory manifestations of the disease may be entirely or predominantly unilateral, or they may be bilateral. The dissociation of sensibility—that is, the occurrence of thermoanæsthesia and analgesia with preservation of tactile sensibility and of the muscular sense—although not absolutely pathognomonic, as it may occur with tabes, hæmatomyelia, Pott's disease of the cervical region, hysteria, and divers forms of multiple neuritis, is by far the most unvarying symptom. If the lateral columns of the cord are encroached upon by the cavity formation, there will be rigidity and paresis of the extremities corresponding to the location of the cavities. The state of the deep reflexes will also depend upon whether or not this part of the cord is involved. If the group of cells from which spring the neuraxons supplying the muscles of the front of the thigh are encroached upon, the knee jerks will be absent. On the other hand, if they are not, and the lateral columns are affected, the knee jerks will be increased. In the atrophied muscles, the electric contractility is diminished in proportion to the degree of atrophy, but true reaction of degeneration is exceptional. Oculopupillary manifestations, consisting of retraction of the eyeballs and narrowing of the palpebral fissure and inequality of the pupils (Schultze eye of German writers), are very common and usually unilateral.

The trophic symptoms vary enormously in different cases. They consist of softness and pultaciousness of the skin, of such eruptions as erythema, eczema, and pemphigus; and of ulcerations, gangrene, and alteration in the nutrition of the nails. The cellular tissue may be the seat of phlegmon, abscess, and lacerations. The joints are sometimes the seats of indolent arthropathies, especially the shoulder, similar to those of tabes, and the spinal column is usually the seat of scoliosis or kyphoscoliosis. The more common vasomotor and secretory symptoms are dermographism, œdema, cyanosis, and increase in the secretion of the salivary and lacrymal glands. The sphincters and sexual functions remain intact.

A symptom complex, known as Morvan's disease, is identical with syringomyelia. It consists of muscular atrophy and weakness of the upper extremities developing simultaneously with analgesia or anæsthesia, extending over the arms, and associated with the occurrence of panaritium on the fingers which leads to deep-seated ulceration and often to crumbling of the terminal phalanges.

The fact that anæsthetic leprosy sometimes produces a syndrome very similar to that of syringomyelia has already been mentioned.

Treatment.—The treatment of syringomyelia consists essentially in

treating the symptoms. No treatment has yet been discovered that has any influence to stay or modify the course of the disease. The general management of a patient with syringomyelia is the same as that described under chronic myelitis. It consists in the adoption of measures tending to so fortify vitality that the progress of the disease and its complications will be delayed. For this purpose use must be made of the ordinary tonics, such as iron, arsenic, and quinine, and of hydrotherapy and massage. Judging from the published reports, nothing is to be gained by the use of medicines directed immediately toward modifying the nutrition of the cord, such as iodide of potassium, nitrate of silver, and chloride of gold, which many believe are of service in tabes. Certain it is that no form of counter-irritation, either over the spinal column or to the skin of the extremities, should be used. The application of electricity may have some slight effect in delaying the rapidity of the muscular atrophy. The trophic manifestations should be treated according to the rules of modern surgery. Abscesses should be opened early, ulcers treated antiseptically, and the parts protected from all injurious agencies. Arthropathies require puncture, arthrotomy, resection of the joints, etc., depending upon the nature, degree and rapidity of the process. Deformities of the spine should be counteracted, if they give rise to symptoms, by the application of an orthopædic corset. The skin should be kept scrupulously clean, and when symptoms of bulbar involvement are present care should be taken in feeding the patient. Rigidity and contractures are oftentimes made more bearable by prolonged warm baths, but anything approaching maceration of the skin is to be avoided. As syphilis and leprosy have no part in the etiology of the disease, treatment directed toward antagonizing either of these as supposed causes should be avoided. Patients afflicted with syringomyelia usually succumb to some infectious process, exhaustions following the occurrence of trophic changes and from hypostatic pneumonia secondary to the entrance of foreign bodies into the lungs through swallowing. Effort should be made to avert these accidents.

CHAPTER XI.

THE TREATMENT OF ACUTE MYELITIS.

The term myelitis has been and is applied both clinically and pathologically with much latitude. It is used to indicate the changes in the cord the result of acute inflammation, disease of the walls and partial or complete obliteration of the lumen of the vessels (myelomalacia), pressure upon the substance of the cord the result of accident, disease, or new growth of the surrounding tissue, and the vascular and parenchymatous changes developing from lessened atmospheric pressure (caisson disease).

The designation acute myelitis should be restricted to indicate an acute exudative and destructive inflammation of the spinal cord involving the white and gray matter, of variable extent in vertical or transverse direction, and occurring at any level. As a rule, the inflammation is of the dorsal or upper lumbar segment, and the focus of the morbid process is more extensive in a transverse direction. Thus the disease is often spoken of as acute transverse myelitis. The pathological products vary with the inflammatory excitant and with the intensity of the infection. The trend of modern scientific thought is to associate the occurrence of inflammation with some bacterial cause, but there is nothing approaching unanimity as to what constitutes the essentials of inflammation or inflammatory reaction. It is quite impossible to distinguish clinically the myelitis which is the result of a pathogenic organism, such as that of influenza or typhoid fever, from the myelitis or myelomalacia that accompanies syphilitic degeneration and thrombus of some of the spinal blood-vessels. Neither is it always possible to distinguish them anatomically, even after the cases come to autopsy, for the exudative and destructive changes that go on around such a focus or a number of foci are practically identical with those of primary inflammation. Indeed, the reactionary changes around such foci may be so great that they more or less obscure them and prevent their ocular demonstration. The pathological product of acute myelitis is seldom pus, except in those rare instances in which the myelitis is due to pyogenic organisms, in which case it may be circumscribed to constitute a more or less diffuse abscess of the spinal cord. Purulent myelitis is almost invariably associated with and secondary to purulent leptomeningitis.

In speaking of the causes and treatment of acute myelitis I shall not attempt to differentiate the myelomalacia due to slowly progressive di-

ease of the spinal blood-vessels, although keenly appreciative of the occurrence of this condition. Indeed it forms the anatomical basis of a certain percentage of cases of myelitis. Compression myelitis, however, will be given consideration in a separate chapter.

Acute myelitis may be classified *regionally* with respect to its location in the cervical, dorsal, or lumbar regions; *topographically* according to major extension as transverse and longitudinal; *etiologically* as traumatic, infectious, toxic, and refrigerant; and *clinically* as acute and chronic. When the inflammation of the cord is accompanied by or is secondary to inflammation of the meninges, it is known as meningomyelitis.

The Etiology of Acute Myelitis.—The causes of acute myelitis are quite the same as those of other acute parenchymatous inflammations. Naturally, certain influences are more harmful to the spinal cord than they are to other tissues. Any depreciation of the circulation and nutrition of the cord, or, in other words, any diminution of its resistivity may act as a powerful predisposing cause to microbic invasion. In this way is to be explained the action of cold, fatigue, especially of the legs, such as is induced by prolonged or violent muscular effort, sexual excess, and trauma insufficient to cause solution of continuity. These factors are usually considered exciting causes of acute myelitis and very frequently some one of them is the sole detectable cause. Of these attributed causes exposure to cold is by far the commonest and most pernicious. It is possible that of itself it is sufficient to excite inflammation in the cord, as this has been done artificially in the lower animals by means of an ether spray. Infection is more liable to occur in early adult life than at any other age. Despite the fact that acute myelitis often develops in the wake of infectious diseases, children are rarely affected. There is no preferential liability with respect to sex other than that engendered by the occupation of males, predisposing by exposure, fatigue, the action of poisons, and the liability to injury, and by pregnancy and the puerperal period in the female. The insignificant seasonal relationship of the disease, viz., its more common occurrence in winter and spring, is clearly related to exposure and cold.

The infections that are most frequently followed by acute myelitis are tuberculosis, syphilis, pneumonia, typhoid fever, erysipelas, diphtheria, influenza, puerperal fever, malaria, gonorrhœa, scarlatina, and variola. Of these the infections of pneumonia and influenza are by far the most pernicious. How these infectious agencies act to produce myelitis is not clearly understood. Of course, their direct presence in the spinal cord would be certain to set up inflammation. But it is much more probable that they produce poisons of the nature of toxins which single out the spinal cord for their pernicious activity. In this way is to be explained the occurrence of myelitis some time after the infectious disease with which it stands in causal relationship has ceased to exist. Whether or not the immediate

pathological precedent of such infectious myelitis is a minute embolus or thrombus, has not been definitely decided, but it would seem that in some cases, at least, this constitutes the first pathogenic step. Acute myelitis has been produced experimentally in animals by the injection of cultures of erysipelas bacilli, colon bacilli, staphylococci, pneumococci, tetanus bacilli, Loeffler's bacilli, Eberth's bacilli, etc. Of the infections, tuberculosis is probably the most common. It is usually but not invariably associated with involvement of the meninges. In a case studied recently I was able to demonstrate the presence of the tubercle bacillus in the myelitic area. Syphilis is the next most important cause of myelitis. Many writers would have us believe that it is the most important cause. It depends entirely upon the interpretation which is put upon the morbid process excited by syphilis, whether or not we agree to this. It has been conclusively proven that syphilis is capable of exciting inflammation of the cord, which conforms to all the requirements of true inflammation. Despite this, the pathogenic evolution of syphilitic myelitis in the majority of cases is a secondary inflammatory reaction, following a softening due to the focal syphilitic disease of one or more blood-vessels.

The poisons that stand in causal relationship to the occurrence of acute myelitis are of endogenous and exogenous origin. The latter are least important, although lead, arsenic, mercury, phosphorus, and carbon dioxide are occasional attributable causes. The rôle played by alcohol in the causation of acute myelitis is not a very prominent one. It acts indirectly by leading to exposure and injury, rather than by its inherent perniciousness on the cord. Toxic agencies arising within the body have a more malign influence. The most important of these are due to diabetes, uræmia, gout, and rheumatism. Acute myelitis sometimes occurs with disease of the urinary organs, such as cystitis and pyelitis. An attempt has been made to explain such occurrences by saying that it was an extension of inflammation or of the inflammatory excitants directly from the tissues primarily diseased to the cord, but this is wholly unlikely, and the myelitis is probably due to injurious agencies circulating in the blood and having their origin from these diseases. The occurrence of myelitis with exfoliative dermatitis and after burns that have denuded a considerable surface of the body is explained in two ways: First, that these lesions allow the development of poisonous substances which are absorbed into the system; and, second, that they act upon the sympathetic system to produce vasomotor derangements in the cord which go on to inflammation similar to those resulting from cold.

Trauma is relatively an uncommon cause of myelitis, except in those instances in which the trauma is sufficient to produce physical disintegration of the substance of the cord, as from fracture and dislocation of a vertebra. Slighter trauma may open the surface to the invasion of bac-

teria, or it may cause marked depreciation of the circulation and nutrition of the cord. We may consider under the heading of trauma the lessened atmospheric pressure which is the immediate cause of the laceration and inflammation of the cord found in all fatal cases of caisson disease. This disease occurs in divers and bridge builders when they return from the diver's apparatus to the outer air. The occurrence of the accident is predisposed to by everything that depreciates vitality and degenerates blood-vessels. It occurs more commonly in those who are unaccustomed to such work and particularly in alcoholic and obese persons. The profound ischæmia which results in the cord and possibly also the occurrence of gas bubbles which have been demonstrated by several observers to exist in the blood, are the immediate antecedents of the laceration, disintegration, and inflammation of the cord.

Myelitis is met with in a number of blood diseases, such as profound anæmia and leukæmia, occurring primarily or secondarily to malignant disease, such as carcinoma, and to some chronic disease, such as nephritis. Here, again, it must be said that the lesions forming the anatomical basis of such forms of myelitis are not true inflammatory ones. Their pathogenesis consists in the occurrence of minute thrombi or emboli, with resulting myelomalacia, which cannot be distinguished from acute myelitis. The acute myelitis that occurs in animals when the blood supply is shut off by pressure upon or ligation of the aorta, and in man with aneurism and partial occlusion of the abdominal aorta, is pathologically a true anæmic necrosis, with subsequent surrounding reactionary myelitis.

Myelitis may be secondary to an inflammation of the surrounding structures—the meninges and the vertebræ—although this is not an important causation. There is some evidence tending to show that it may be secondary to an ascending peripheral neuritis, particularly from the nerves of the trunk. Such a case has never come under my own observation.

Symptoms.—The symptoms of acute myelitis vary with the location and extent of the lesion. The introductory symptoms, which are independent of the location of the inflammatory foci, may come on with great abruptness, constituting the apoplectic variety, or in a few days, constituting the acute variety, or in a few weeks and often somewhat intermittently, constituting the subacute variety. Usually the first sensory and motor irritative symptoms are followed by more or less complete paraplegia. When the lesion is of the dorsal cord, its commonest location, the symptoms consist of paraplegia, pain in the back radiating into the trunk and legs, and more or less anæsthesia, paralysis of the bladder and eventually of the rectum; exaggeration of the knee jerks and later spasmodic twitchings and contractions of the leg; vasomotor and trophic disturbances, consisting of bedsores, slight œdema of the legs, coldness of the extremi-

ties, and occasionally the formation of bullæ. The muscles do not atrophy, and there is no reaction of degeneration. When the inflammatory foci are in the lumbar region, the paraplegia that occurs is of the flaccid variety, and there is atrophy of the muscles with reaction of degeneration. The skin reflexes are weak, and the tendon reflexes are usually lost. There is a variable amount of anæsthesia in the paralyzed parts, and the rectal and vesical insufficiency is profound. When the myelitis is of the cervical cord, the general symptoms are more profound and there is in addition to the symptoms indicative of dorsal myelitis motor paralysis of the arms or of individual muscle groups, usually of a spastic character. There may likewise be oculopupillary symptoms, disturbance of respiration, and bradycardia. If the lesion is adjacent to the oblongata, the bulbar symptoms will be more pronounced.

The course of the disease is naturally a progressive one for a short time, and then it becomes more or less stationary with resulting secondary degeneration, ascending in the sensory tracts and descending in the motor tracts, the latter predominating. The disease eventually causes death by exhaustion and by infection from the urinary organs and bedsores.

Treatment.—Considering the almost invariable outcome of acute myelitis, the treatment of the disease is thankless and dispiriting. Nevertheless much can be accomplished by appropriate treatment to limit its extent, to alleviate suffering and misery, and to avoid in a measure some of the distressing secondary occurrences. The possibility of an abortive treatment of acute inflammation of any organ is problematical, but it is certain that there is none for an acute inflammation of the spinal cord. Yet something can be accomplished in the direction of lessening the intensity of the inflammation and shaping its course toward partial restitution. The appropriate treatment naturally varies with the cause of the disease, although all varieties of acute myelitis call therapeutically for two things: first, *absolute rest;* and second, *absolute cleanliness.* It may legitimately be said that just in proportion as these two requirements are obtained so will be the partial recovery of the patient and the duration of life. The patients should be put to bed and kept there, and they should not be allowed to move under any circumstances. The change of position which is advisable, either to keep the parts on which pressure is most severe from becoming the seat of bedsores or to influence the circulation in the cord, should be done by an attendant. It is advisable, if the condition of the patient allows it, to have him lie on the belly or side for a part of the time. The greatest care should be expended in the selection of a mattress and in the arrangement of the coverings and clothing of the patient, so that irregular pressure on the surface of the body is avoided. Whenever it is at all possible, the patient should at once be put upon a water bed. Unfortunately, the physician sometimes

awaits the occurrence of trophic symptoms before insisting upon this. Much trouble and suffering can be avoided by ordering it at the beginning. The most scrupulous cleanliness must be insisted upon. Warm water and soap should be used at least twice daily, followed by rubbing of the skin with alcohol and by dusting of the most bland antiseptic powder. The condition of the bladder and bowels should be made an object of special attention from the start. If they are neglected, symptoms are sure to develop which point to infection, intoxication, and depreciation of vitality, and which will seriously jeopardize the patient's life. When it is impossible to catheterize the patient regularly, males should be provided with a urinal so adapted that every drop of urine passes into it, while females should have absorbent cotton surrounded by gauze or oakum so arranged that it catches every drop, and this should be renewed every two hours at least for the first few days, and after each renewal the parts thoroughly cleaned. The bowels should be moved regularly by the use of simple enemas. If there is incontinence of fæces, efforts to secure and maintain cleanliness must be doubled.

If the myelitis is post-infectious, the treatment required, in addition to that mentioned above, consists in the administration of medicines that prompt the emunctories to activity, so that the elimination of the poison from the system may be facilitated. It is advisable to give an intestinal laxative and antiseptic, such as a dose of calomel followed by a saline, and a few brisk doses of some bland diuretic and diaphoretic, particularly if the patient is a robust, full-blooded individual, and to follow this by the administration of small doses of salicylates and quinine, both of which, fortunately, tend to alleviate the pain. If the case is seen at the beginning, it is very advisable to put an ice-bag over that portion of the spine at which the lesion is situated whenever an opportunity is offered by the position of the patient. All forms of stimulant and irritant applications to the spine should be rigorously avoided during the acute stage of the disease. The skin is subject to profound depreciation of nutrition and it does not tolerate such irritation. The insignificant benefit to be derived from such applications is enormously disproportionate to the chances that are taken of causing or hastening decubitus. Of the drugs that have been recommended for their specific action upon the inflammatory process, two only need be mentioned—ergot and belladonna, and these to be advised against. The use of ergot has been common for many years, but experienced physicians are gradually losing faith in it. I have never seen anything approximating benefit result from its use. The same may be said of belladonna, although the latter may exercise a stimulating effect on the bladder and be of some benefit. Pain should be relieved by the administration of phenacetin, combined with one of the salicylates, and by morphine, which should not, however, be given hypodermatically. Involuntary twitchings of the lower extremities are best controlled by the latter

drug, but when they are not very severe they can be mitigated by the occasional administration of a dose of one of the bromides. The fact that this latter drug is a vasomotor depressant, however, should not be lost sight of.

When the myelitis is due to syphilis, or to vascular diseases, such as anæmia and leukæmia, in brief, when there are grounds for the belief that the myelitis is in reality a myelomalacia, with secondary inflammatory reaction, the treatment is somewhat different. In such cases the administration of eliminatives, the application of cold, and the giving of drugs that have any lowering influence upon the circulation are contraindicated. We can judge of the existence of these conditions only from the history of the patient and the accompanying manifestations. Such patients require supporting, stimulating, and alterative treatment from the beginning. It does not seem that active antisyphilitic treatment is of signal service in such cases, even though there be a distinct syphilitic history. Of course, such treatment is indicated, but it must not be carried out in the beginning to the exclusion of treatment looking toward the restitution of the blood-vessels that are the seat of degenerative and exudative changes. The general treatment is the same as given above, but should include in addition small doses of cardiac stimulants, such as strophanthus and digitalis, combined with moderately increasing doses of iodide of potassium. If the myelitis is secondary to blood diseases, the treatment is the adoption of measures looking to the cure of the condition to which the myelitis is secondary, and the administration of substances that support the patient's vitality. The same may be said of myelitis occurring secondary to autointoxications. They are to be combated directly quite apart from the superadded occurrence of myelitis, but the latter is to be treated as well. It is unnecessary to enumerate the special indications of causal therapy in each one of these conditions.

In all cases care should be taken to brace the patient to withstand the onslaught upon his vitality and to maintain as far as possible the integrity of the peripheral circulation. The first is to be encompassed by careful administration of nutritious, easily digested food, given frequently and in small quantities, and if necessary by the administration of alcoholic stimulants in small quantities. The second can be accomplished in part by the application of dry heat to the lower extremities, by frequent and prolonged immersions of the extremities or the entire body in warm water, after which they are wrapped in cotton wool, and by the use of mild massage. It must again be mentioned that the vitality of the skin is such that it will resent rough handling of any kind, and care must be taken in the application of hot-water bottles and in the use of manual friction.

Electricity has been recommended for its attributed efficacy in mitigating certain symptoms, such as incontinence of urine, for preventing muscular atrophy, and for its direct effect upon the spinal cord. It may

be stated positively that it should never be used with any such end in view as specific action on the cord. In some cases it would seem that a large electrode connected with the positive pole and placed above the pubes over the bladder and the negative on some indifferent point, while a current of from two to three milliamperes is allowed to flow, is of some service. After the acute stage has subsided, either the faradic or the galvanic current may be used to stimulate muscular contraction and especially to prevent inactivity muscular atrophy. As a rule, it may be said that it is much safer not to use electricity during the acute stage.

In some cases, even in those in which the greatest care has been expended in carrying out the essential requirements in the treatment of every case of myelitis, viz., rest, cleanliness, frequent change of position, absolutely smooth surface to lie upon, tonifying measures, etc., untoward symptoms such as cystitis, pyelitis, bedsores, and other trophic phenomena occur which require particular and careful treatment. Such treatment, however, is not at variance with the treatment applicable to similar conditions developing under other circumstances. Cystitis occurring with myelitis requires for its successful treatment a careful study of the urine and the administration of substances that make it as bland and unirritating as possible, and the local or intravesical application of substances that combat the inflammation. Frequent and thorough irrigation with plain warm water, or, better still, with some simple alkali and antiseptic solution, such as a five-per-cent solution of boracic acid, a two-per-cent solution of salicylic acid, or extremely weak solution of nitrate of silver (1:1,000) should be used two or three times daily. Vesical irrigations with carbolic-acid solution and sublimate solution have been recommended, but their virtues are not sufficient to counterbalance the discomfort and danger attending their use. Pyelitis is to be treated according to general principles of rest, administration of large quantities of water, and small doses of salol, with the same attention to the diet as indicated in the ordinary case of pyelitis. Bedsores are to be treated the same as acute ulcers occurring in a debilitated subject with antiseptic solutions and dressings. The danger of attempting to stimulate them to healthy reaction is great. When they cannot be controlled in this way, the patient must be put for a time in a permanent warm-water bath.

After the acute stage of the disease has passed comes the time for the adoption of measures looking to the absorption of the inflammatory remains and the mitigation of the consequences of the injury. The nutrition of the patient should be carefully studied. It is not only necessary to administer appropriate food, but to get the patient in the fresh air by means of an invalid roller chair if unable to walk, to administer measures that contribute to sleep, overcome constipation, and to maintain nutrition of the muscles and the integrity of the peripheral circulation by massage, passive exercise, and as much active exercise as it is possible for the pa-

tient to take. It is at such times and later that regular cures should be undertaken, either at home or abroad, at thermal springs and health resorts, such as the Hot Springs of Arkansas and Virginia, Glenwood Springs of Colorado, Richfield Springs of New York, Lamalou of France, Nauheim and Oeynhausen of Germany, and such places that have obtained repute in the treatment of different varieties of degeneration of the spinal cord. A sojourn at one of these places frequently results in much greater benefit than can be explained by the taking of the waters internally or externally. It not infrequently improves the patients' morale; the observances there require the maintenance of great cleanliness which in turn betters the peripheral circulation, and the disciplinary measures to which they are subject facilitate metabolism, and increase the appetite. All of these are of the greatest importance. Many men experience a partial or temporary restoration of the sexual power from such treatment; this improvement benefits them by inspiring hope and imbuing confidence.

In cases of myelitis secondary to diathetic conditions, this is the period when there is some hope of using constitutional and non-medicinal measures to great advantage. It is also the period when rigorous antisyphilitic treatment should be carried out if such treatment seems to be indicated, as it is in every case in which there is a syphilitic history, whether or not the patient has had what seems to have been adequate treatment following the infection.

CHAPTER XII.

THE TREATMENT OF COMPRESSION MYELITIS.

Compression of the spinal cord may be caused by neoplasms or inflammatory growths that take their origin from the cord itself, from the meninges, from the cellulo-adipose tissue, and from the vertebræ. The amount of pressure which the growth will exert upon the cord depends, naturally, upon its situation, size, and consistence. The lesions that most frequently cause compression myelitis have their seat in the dorsal region. The amount of compression that the cord often tolerates before its functions are seriously interfered with is remarkable. Tuberculous caries of the vertebræ and tuberculous disintegration of the intervertebral discs, Pott's disease as it is commonly called, is the most frequent cause of compression myelitis. The next most common causes are tumors of the meninges, sarcoma, fibroma, multiple sarcomatosis, syphiloma, myxoma, and other rarer forms. Chronic inflammations of the meninges, especially of the dura, such as traumatic, tuberculous, and syphilitic pachymeningitis, constitute the next most important cause of compression myelitis. These diseases are generally associated with a variable amount of circumferential or annular myelitis, which occurs coincidently with the involvement of the meninges. Oftentimes, however, the implication of the cord is distinctly secondary to the lesion of the dura and is the result of compression. Tumors having their origin in the extradural cellulo-adipose tissue are a rare cause of compression myelitis. When such tumors are primary they are usually lipomatous; when secondary, carcinomatous. Aneurismal dilatation of the thoracic and abdominal aorta occasionally causes erosion of the vertebræ and penetrates the vertebral canal so as to produce pressure upon the cord. The most uncommon causes of compression myelitis are tumors of the vertebræ themselves, which are almost always a variety of cancer secondary to cancerous formation in other parts of the body, and fractures and dislocations of the vertebræ. Tumors of the cord substance itself do not cause true compression. They merely replace the substance of the cord and produce symptoms similar to those of compression myelitis proportionately to the amount of the replacement. Such tumors are almost exclusively gliomatous.

The variety of compression myelitis resulting from Pott's disease is clinically, especially therapeutically, the most important. In just what way tuberculous caries and the consequent disintegration of tissue and

deformity cause compression of the cord is a very debatable question. It has been contended that the compression is the direct result of the angular spinal curvature or kyphosis which the softening and displacement of the intervertebral discs and subsequent partial dislocation cause in other words, that the compression is purely mechanical, but against this is the important fact that symptoms of compression occur when there is no considerable curvature, and they are often absent when the angular deformity is most extreme. As a matter of fact, the compression of the cord in Pott's disease is commonly due to an accompanying external pachymeningitis secondary to the tuberculous process. In rare instances it is due to the presence of extradural abscess. Pott's disease occurs usually in childhood and early adult life. The causes that predispose to the occurrence of tuberculosis in any other part of the body are the contributing causes of the disease, the exciting cause being the tubercle bacillus. In some cases injury to the spine seems to have direct causal relationship. It produces disorder of circulation and perversion of nutrition which facilitate the foothold of the infection, or it accelerates the disease process which has already begun.

The causes of tumors of the spinal cord, its membranes, and the immediate environmental tissues are unknown, aside from the infective granulomata, tuberculous and syphilitic, and the parasitic diseases. We know, for instance, that glioma and sarcoma are more likely to occur in the young than in the old, and that carcinoma and fibroma are more liable to occur in late adult life; but aside from this absolutely nothing is known, except that occasionally preceding trauma has some etiological influence, the same as it has in the development of brain tumor.

The etiology of compression due to traumatisms of the spine—fractures, dislocations, gunshot wounds, etc.—requires no further discussion, as it varies with each case.

Symptoms. The symptoms of compression myelitis vary according to the level of the cord that is encroached upon, and with the rapidity and [illegible] of compression. Practically they are the same as those of acute [illegible] myelitis of the dorsal region plus sensory symptoms, of which [illegible] are the most conspicuous. This pain is local, usually somewhat below [illegible] of compression, and radiates along the trunks of the nerves. [illegible] pain is not accompanied with local tenderness on pressure [illegible] pseudo-neuralgia. The pain is variable in character, [illegible] and subject to exacerbation. It is increased by [illegible] of all kinds, active and passive. It is mitigated by [illegible] to nerves of the spine it is usually symmetrical, but in [illegible] with the extradural variety, it is not infrequently [illegible]. It is accompanied by various sensory phe[illegible] hyperæsthesia, polyæsthesia. The motor symptoms [illegible] of the spine, and more or less complete

paralysis of the extremities. The paralysis may be flaccid or spastic, usually the latter, and accompanied with exaggerated reflexes. Although the paralyzed parts may be quite anæsthetic, the patient still complains of pain in them, and this condition is known as paraplegia dolorosa. The bladder, bowels, trophic symptoms, vasomotor and secretory disturbances are the same as those of acute myelitis. These symptoms vary naturally with the causation and with the location of the compression. The important symptoms in Pott's disease are the stiffness and rigidity of the back, the deformity, and the radiating pain.

The treatment of compression myelitis must vary according to its causation. The treatment for compression due to Pott's disease is not the same as that indicated for compression dependent upon tumors or upon fractures and dislocations.

Treatment of Compression Myelitis Due to Pott's Disease.—The treatment of compression myelitis due to Pott's disease consists of rest, the adoption of measures to improve the general nutrition, and the utilization of orthopædic apparatus to maintain immobilization of the portion of the spinal column diseased. Medicinal and hygienic treatment are of great importance, as they are in every form of tuberculosis, but in the early stages of the disease the most urgent requirement is rest. The patient should be put to bed and kept in as nearly a horizontal position as possible, and extension of the spine secured through axillary traction if the caries is of the dorsal region, or pedal traction if it be lower down. During this time the dietary should be most liberal and nourishing, while utilization of the foodstuffs is facilitated by abundance of fresh air. Not infrequently the early stages of the disease are accompanied by fever, and it is wise to combat this on account of its depreciating effect upon nutrition by the administration of small doses of quinine and phenacetin and the external use of cold water. Two drugs, creosote and iodide of potassium, may be given for their constitutional effect. In my own experience the latter drug, given in large doses (gr. xx.-xl. three times a day for an adult) and appropriately, is by all means the most reliable medicament. After the acute manifestations of the disease have subsided, support and extension of the spine should be obtained by the plaster jacket if the disease is of the dorsal spine, or the Sayre jury-mast if it is of the cervical spine. There should be no relinquishment of the effort to maintain a high degree of nutrition during this period. The treatment of vesical, rectal, and vasomotor symptoms accompanying compression myelitis is the same as for acute myelitis. I would warn particularly against the use of counter-irritation to the spine in any form. Formerly it was the custom to employ the actual cautery, blisters, and vesicants to the spine. They add to the patient's suffering without being in the slightest way beneficial. Many cases of Pott's dis-

ease, if taken sufficiently early and subjected to appropriate treatment, terminate in at least partial recovery, even though the symptoms of compression of the cord have been well pronounced. This is especially true in children. Occasionally the improvement is very rapid, but usually it occurs gradually. After the pressure on the cord has been relieved, and the inflammatory process has subsided, measures looking toward the functional restitution of the extremities must be adopted. For instance, muscular contracture must be overcome. In some cases this can be done by massage and passive exercise, but occasionally it requires tenotomy and orthopædic appliances. Muscular atrophy and weakness are to be combated by massage and the hypodermatic use of strychnine, while an attempt is made to restore the circulation of the formerly paralyzed or partially paralyzed extremities by the use of hydriatics.

Treatment of Compression Myelitis Due to Spinal Tumors.—The treatment of compression myelitis due to spinal tumors is very discouraging. Tumors of the spinal-cord substance are entirely unamenable to every form of treatment, and all that can be done is to treat the patient symptomatically—relieve the suffering and maintain the strength and vitality. Treatment of tumors of the vertebræ is quite as hopeless, for such tumors are almost invariably secondary and are beyond the skill of the surgeon. Tumors of the meninges are amenable to surgical treatment, and the results of operations so far undertaken may truthfully be said to be encouraging, although they are by no means brilliant. If tumors can be diagnosticated before they have made serious pressure upon the cord, and particularly if they can be removed before secondary degeneration resulting from such pressure has gone on, the requirements will be amply fulfilled. Tumors of the spinal cord have not been considered amenable to surgical measures until recently. In 1887 Horsley operated upon such a case and since then at least twenty-three cases have been recorded. About thirty per cent of these have been either materially improved or cured, the remaining number died principally from hemorrhage, shock, and sepsis. But without operation they would all have died, excepting possibly a few cases of syphiloma. Even these results are therefore encouraging.

The treatment of traumatic affections of the spinal column causing compression myelitis may be dismissed with brief consideration. The treatment varies according to the nature and degree of the accident. Many methods have been devised for the reduction of dislocations of the vertebræ. Such dislocation is commonly of the cervical region, and here attempts at reduction are almost invariably followed by death. At the present time it would seem that the most justifiable mode of attempting reduction is by continuous extension, such as with Sayre's apparatus. When reduction cannot be effected the advisability of exposing the joint and ligaments implicated must be considered. Fracture of a vertebra

followed by symptoms of compression requires exploratory trepannation in every instance. The surgeon must then be guided in his further procedure by the conditions to be found in each case. The symptomatic treatment in these cases is the same as the symptomatic treatment for ordinary myelitis.

CHAPTER XIII.

THE TREATMENT OF CHRONIC MYELITIS.

Etiology.—The causes of chronic myelitis are: (1) All the causes of acute myelitis, as the chronic variety may be one mode of termination of the acute; (2) syphilis, which is by all means the commonest single cause, it being found in at least one-third of all the cases; (3) poisons, such as ergot, which has the peculiarity of causing destruction particularly of the posterior column, alcohol, lead, mercury; (4) autointoxications, gout, diabetes, and chronic anæmia. The predisposing causes are practically the same as those of acute myelitis. Exposure to cold and wet is the attributed cause in many of them. Fatigue and prolonged physical activity and strain are noted in many others. The disease is likely to occur during the years of early maturity, and much oftener in males than in females.

A variety of chronic myelitis dependent upon senile changes in the spinal blood-vessels, senile arteriosclerosis with resulting perivascular sclerosis, occurs occasionally in old age and is known as senile paraplegia.

Of 40 cases diagnosticated as chronic myelitis and treated in my clinic 32 were males and 8 females. The average age of the patients was thirty-seven years. Out-of-door manual laborers furnished 42 per cent of the entire number. Fourteen of the 32 patients gave a history of syphilis, and in 11 of these the symptom complex of myelitis conformed to the type known as syphilitic spinal paralysis. Thirty-three per cent of the cases gave a history of exposure to cold, and in the majority of these the refrigeration was considered the cause of the disease by the patient. In 15 per cent of the entire number the disease was secondary to acute myelitis, and in the majority of these there was a history of acute infection, such as influenza or pneumonia, or of exposure. In 8 per cent of the cases there was a history of injury without evidence of its previous existence. One patient had diabetes and 2 suffered from severe and chronic anæmia. Only 1 case was of the senile variety.

The symptoms of the variety of chronic myelitis known as syphilitic spinal paralysis are: 1. Gradual onset with or without attributable exciting cause, usually within five years after the patient has had the initial lesion of syphilis. 2. Weakness of the legs associated with muscular rigidity and contracture. This weakness may amount to complete paraplegia. Often one extremity is more profoundly affected than the other. 3. Great increase of the tendon reflexes. 4. Weakness

and functional disorder of the bladder, and occasionally also of the rectum. 5. Slight but constant sensory symptoms in the shape of paræsthesia of the legs; severe pain is unusual. 6. Loss of sexual potency. 7. About one-third of the cases respond favorably to active antisyphilitic treatment. Occasionally such a patient gets quite well.

The symptoms of chronic myelitis which is sequential to the acute variety will depend very largely upon the severity of the original process. They are practically the same as those of acute myelitis save that they are less profound. When chronic myelitis is chronic *ab initio*, as from exposure and exhaustion, the symptoms usually consist of: 1. Heaviness and easily induced fatigue of the legs; 2. Stiffness of the lower extremities in the beginning, particularly after arising and after resting, but later the stiffness is constant; 3. Urinary symptoms, manifest particularly in difficulty in emptying the bladder, later incontinence; 4. Impaired sexual capacity; 5. Variable and inconstant sensory symptoms, consisting of objective numbness of the legs and feet, tension around the lumbar and lower abdominal regions, and occasionally paræsthesia of different parts of the lower extremities. The symptoms of the senile variety are a gradual development of a slightly spastic paraparesis associated with mild vesical symptoms. These symptoms become more pronounced and oftentimes the arms present analogous but less marked symptoms. In some cases arteriosclerotic changes in the brain, similar to those responsible for the senile paraplegia, produce the symptom complex of senile dementia or other symptoms of encephalomalacia.

Treatment.—The treatment of chronic myelitis divides itself into treatment of the syphilitic cases and the non-syphilitic. In the former the amount and duration of antisyphilitic treatment which the patient will tolerate must be decided in each case. We are guided largely in reaching a conclusion by consideration of the length of time that has elapsed since infection, the amount of antisyphilitic treatment which the patient has already received, and the state of his general nutrition. The more removed from the time of infection, the less the chance of profound and permanent improvement from antisyphilitic treatment. Patients of good vitality and nutrition are much more liable to be benefited by antisyphilitic treatment than the cachectic. Aside from this and the causal treatment of myelitis, mentioned in the discussion of the acute variety, the treatment consists in so arranging the patient's life that he is insured from bodily and mental agitation and fatigue, that he is spared the injurious action of alcohol, tobacco, and narcotics, and that he is vouchsafed a life of intelligent rest and exercise. These, and the employment of agencies to meet the symptomatic conditions and measures to improve the nutrition, constitute the entire treatment. As soon as the paraplegia reaches that degree of development that locomotion is difficult and fatiguing, the patient should be encouraged to get about in a roll-chair.

Spasticity is to be combated by frequent warm baths of from ten to fifteen minutes' duration. Many patients receive benefit and much comfort by remaining in such a bath for an hour or even longer.

Electricity is of no service in influencing the course of the pathological process. If there is muscular atrophy, of inactivity or of other origin, electricity may be used with some success to combat these conditions. But as a rule both the galvanic and the faradic current tend to increase the spasticity, and should not therefore be used. Massage and passive exercises are much more useful. Massage not only improves the circulation and the nutrition of the parts, but when combined with gymnastics tends to preserve mobility and to facilitate voluntary movements.

Internal medication with the object of overcoming the lesion in the spinal cord is not very encouraging. Nitrate of silver has been recommended, but it is useless; ergot has been praised, but it is injurious. Phosphorus and arsenic have been given, but no one can say positively that they do any good; if they do, it is probably by improving the nutrition. Strychnine is a drug that is used extensively in this disease by the general practitioner. But aside from its stimulating effect on the bladder, I have never seen any beneficial effects follow its use. By increasing the spasticity it may hamper the patient's locomotion and it may exaggerate the involuntary contractions, which are so annoying, especially at night, to many patients.

Local treatment over the spine, such as the application of the cautery, counter-irritants, vesicants, etc., and especially the former, are sometimes of service. Such treatment seem to have quite as important a psychical effect as physical.

The general health is frequently bettered by the employment of a mild cold water cure. This has beneficial effect in that it makes the patients feel that something is being done for him. The symptomatic treatment is the same as in acute myelitis. The condition of the bladder and of the skin should be made objects of special solicitude.

Subacute Ataxic Paralysis and Combined Sclerosis.

(Primary Myelitis Associated with and probably Dependent upon Lethal Anæmia and Toxæmia.)

During the last decade much labor has been expended to interpret the relationship existing between certain profound changes in the blood and a peculiar and systematic decay of the spinal cord. That such a form of disease existed had previously been recognized by clinicians, attention having been specially called to it by Putnam, of Boston, and Dana, of New York. While it is properly classified with chronic myelitis, a summary of our present knowledge of the disease, as given by Dana in his last contribution on the subject, will be here given.

The symptom complex of the disease consists of numbness, ataxia, and paralysis first manifest in the lower extremities, then in the upper, of insidious onset, but after the disease has got well under way it progresses very rapidly, usually terminating fatally in from six to twenty-four months. The phenomena of cachexia are always conspicuous. The cause is not known, but the trouble is due beyond much question to some form of toxæmia. It is more often associated with pernicious anæmia or profound secondary anæmia than with any other individual condition. It sometimes develops with profound malaria and lead intoxication. It occurs usually in middle life or later and oftener in women than in men. It is to be recognized mainly by the presence of anæmia or cachexia, the age of the patient, the progressive and rather rapid character of the symptoms, absence of much pain or tenderness over the nerves, and the absence of the eye symptoms and of the visceral symptoms of locomotor ataxia. The pathological anatomy consists in a progressive degeneration of the posterior columns, to a lesser extent of the lateral columns, and later of other parts of the gray and white matter. In the beginning the disease is systemic, affecting most severely the cervico-dorsal cord, but later foci of degeneration, usually multiple, develop in the dorsal and lumbar segments of the cord. Pronounced changes in the blood-vessels sometimes accompany the degeneration, which is non-inflammatory and often ends in softening.

The treatment of the disease consists in early detection of the poison or infection of the blood upon which it is dependent and the adoption of measures that will overcome or counteract them. In the earlier stages the course of the disease may be modified by the administration of arsenic, quinine, tonics, proper feeding, and the transfusion of artificial serum, normal salt solution. Treatment is always ineffective in the later stages.

CHAPTER XIV.

THE TREATMENT OF INFLAMMATION OF THE CENTRAL GRAY MATTER (POLIOMYELITIS AND POLIOENCEPHALITIS SUPERIOR AND INFERIOR).

The gray matter of the central nervous system is far more susceptible to the injurious activities of infections, intoxications, and other depraving agencies than the white matter. Its vascular supply is more abundant and complex, and its constituents are the parts of the neurons in which the nutrition of the neuraxons and their distant ramifications are regulated. This gray matter may be the seat of as many different varieties of inflammation as any other tissue of the body, or as there are excitants of inflammation. The commonest varieties of inflammation of the gray matter are acute exudative, non-hemorrhagic, and hemorrhagic inflammation. The next most common are the acute proliferative and purulent inflammations. The gray matter of certain levels seems to be more prone to inflammation than that of others. Moreover, certain excitants of inflammation of the gray matter seem to have a predilection for individual parts. Thus the banefulness of influenza is liable to be expended on the gray matter of the cerebral hemispheres, that of alcohol upon the gray matter around the aqueduct of Sylvius, while the infectious intestinal diseases and the intoxications following them are likely to manifest their perniciousness upon the gray matter of the spinal cord. Naturally, there is nothing approaching a rule which governs such predilection. In a general way it may be said that the causes that predispose to and excite inflammation in one segment of the gray matter of the central nervous system may do so in another.

Although the diseases of similar inflammations in the different segments of the central gray matter are clinically quite unlike and therefore must necessarily be considered separately, the fact that they are similar etiologically and pathologically leads me to consider them together. Thus inflammation of the central gray matter of the spinal cord is called spinal poliomyelitis, while inflammation of the gray matter of the oblongata is called bulbar poliomyelitis. Inflammation of the gray matter surrounding the floor of the fourth ventricle is called inferior polioencephalitis, and inflammation of the gray matter surrounding the third ventricle and the aqueduct of Sylvius is known as superior polioencephalitis. If the inflammatory process is of the gray matter of the cerebral hemi-

spheres, it is called encephalitis. The morbid anatomical changes found in all of these conditions are very similar, and they may be, and often are, the immediate sequences of infectious disease. With one exception, superior polioencephalitis, the most common cause of which is alcohol, the etiology of these diseases is the same in nearly every particular. They all occur most frequently in the young and in the wake of acute diseases, and the clinical course of the various conditions does not differ very materially. Cases of anterior poliomyelitis and of superior polioencephalitis are apt to run a much more rapid course than cases of inferior polioencephalitis and bulbar poliomyelitis, but to this rule there are the most striking exceptions. Two or more of the conditions that we have enumerated may occur simultaneously and be the expression of a widespread pathological process due to a single cause, such as an infection; usually, however, although there may be in the beginning symptoms indicating involvement of what we may call functionally different levels of the central nervous system, the symptom complex soon confines itself to the clinical portrayal of more or less narrow anatomical involvement. Therefore I shall take up successively: (1) The treatment of anterior poliomyelitis; (2) the treatment of bulbar myelitis; (3) the treatment of inferior and superior polioencephalitis; while acute myelitis and acute encephalitis, even though the pathological process constituting them and the causations of them are similar to the diseases that are here mentioned, will be treated separately.

1. Anterior Poliomyelitis.

The term poliomyelitis means inflammation of the gray matter of the spinal cord. As such inflammation is almost invariably restricted to the anterior horns, it is quite unnecessary to prefix the word anterior to indicate the locality of the gray matter implicated in the disease known clinically as infantile paralysis and essential palsy of children. The name has taken a definite place in nosonomy, however, and therefore no attempt should be made to dislodge it. For a long time following the recognition of poliomyelitis, both clinically and anatomically, it was believed that the disease occurred exclusively in children. It is now universally recognized that poliomyelitis occurs during adult life, and in many books separate description is given of its occurrence at this age. This is quite unnecessary, however, for the causation, clinical course, outcome, and treatment of the disease are the same in both instances.

Poliomyelitis may be acute or subacute in its development and course. A chronic variety has been described as the co-equal of spinal progressive muscular atrophy. It is dependent largely upon the use put upon the word inflammation, whether or not the gradual shrinkage, atrophy, and decay of the ganglion cells in the anterior horns which form the anatomi-

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peripheral nerves which they go to form, and the intramuscular distribution of these nerves within the actively contractile part of the muscle—in other words, the entire peripheral motor neuron—decay when the cell body is destroyed by the inflammatory process which forms the anatomical basis of anterior poliomyelitis.

All that is known concerning the causation of the disease in addition to what has already been stated is that it sometimes follows in the wake of the infectious diseases; that it occurs during the late summer, and especially in seasons of extreme sultriness; and that fatigue, excitement, exposure to wet and cold, overheating, and in general factors that exhaust the nervous system, are oftentimes immediate precedents of the occurrence of the disease, both in the infant and the adult. In one recorded instance the disease followed a wound upon the knee, to stanch the bleeding of which moss from the roadside had been used. The vast majority of cases occur between the first and fourth years.

Symptoms and Course of the Disease.—The premonitory symptoms of the disease are those common to all the milder forms of infection, such as apathy, disinclination to play or work, somnolency, feeling of stupidity, and a desire to be left alone. Within a few hours, a day or two at the longest, the patient has considerable rise of temperature, reaching 102° or 103° F., which lasts from twenty-four to forty-eight hours in children and oftentimes for a week in adults. It may or may not have been preceded by chilly sensations, but it is usually accompanied in children by manifestations of irritation of the central sensory sphere, such as vomiting, convulsions, flightiness, irritability, and a serious disinclination to be handled, as if severe pain were caused thereby. After these symptoms have lasted from one to three days, it is noted that the patient is paralyzed in one or all of the extremities, usually one of the lower extremities. As time goes on, what seems to have been loss of function of an entire extremity may disappear and the paralysis restricts itself to a single muscle or a group of muscles, especially those functionally associated. At this time atrophy of the muscles begins to show itself with some distinctness, although for many days the limb may retain its normal contour, and particularly if there is much subcutaneous fat. But the fact that it is atrophying is plainly apparent to the touch. Before and during this time the functions of the bladder and rectum have been disordered. This of course will be evident only in patients who are of an age to be observant of the calls of nature. In the beginning of the disease the patient feels sore all over and there is frequently much complaint of pain. But after the general phenomena of inflammation subside, there are no sensory disturbances, subjective or objective, although enduring pains in the extremities have occasionally been noted. When such symptoms occur they indicate an involvement by the inflammatory process of the posterior cornua and the root fibres passing therein.

As the individual muscle or group of muscles continues to atrophy certain accompaniments easily recognized on examination develop. These are loss of the tendon jerks, such as the knee reflex, when the muscles through which these reflexes are manifest are diseased, and some degree of reaction of degeneration to the faradic and galvanic currents, both in the nerve and in the muscle. The degree of completeness of the degenerative reaction varies in every case. When the atrophy is profound, there is usually complete absence of contraction both to the faradic and to the galvanic currents, but in other instances some faradic excitability of the muscle remains, a possession that augurs well for the recovery of the part. The atrophy usually reaches its height in from four to eight weeks after the occurrence of the disease; but it becomes more striking after this because in greater contrast to the progressively growing limb of the other side or groups of muscles of the same extremity. If the atrophy has involved an entire limb, no considerable deformity may result save that of a withered, undeveloped extremity; but usually the atrophy limiting itself to a group of muscles is followed by very marked deformity, particularly of the feet, different forms and degrees of club-foot, which is caused by the unopposed contraction, the basis of muscle tonus, in antagonistic groups of muscles. The prevention of such deformities forms an important part of the treatment of poliomyelitis. The course of the disease is indicated in the above description. The prognosis is unfavorable if complete recovery is the standard by which such forecast is made. As a rule, the life of the patient is not endangered unless the inflammatory process is of great extent and profound severity, when the respiratory muscles may be involved.

Treatment.—The treatment of poliomyelitis may be considered under four headings: 1. The prophylactic treatment. 2. The treatment of the febrile period. 3. The treatment of the immediate manifestations of the disease, particularly the muscular atrophy and its consequent paralysis. 4. The treatment of the remote consequences of the disease, deformities.

Prophylaxis.—Very little that is of service can be said regarding the prophylaxis because the definite etiological factor has not yet been differentiated. Considering the relationship which the occurrence of poliomyelitis has to the acute infectious diseases, the advisability of looking to the hygiene of the convalescence from these infections is apparent, likewise the importance of avoiding the exciting factors that have been enumerated above, and particularly during that time of the year when poliomyelitis is likely to occur. When the disease is prevailing epidemically, the greatest care should be taken to avoid all experiences that cause lowering of vitality, while the condition of the alimentary tract in children should receive especial attention.

Treatment at the Time of the Attack.—The appropriate treatment during the febrile period is an ice-bag over the spine, or if this is impos-

sible on account of the age of the patient, the application of dry cups or a few leeches; the exhibition of repeated small doses of calomel, followed by a saline; and the administration of salol and phenacetin to control the fever, relieve pain, and to combat intestinal fermentation. Unfortunately, however, in the majority of instances, no suspicion is had of the nature of the disease, unless it be prevailing epidemically, until the febrile period has passed and the paralytic manifestations call attention to the fact that it is a spinal-cord affection. The occurrence of convulsions calls for inhalations of chloroform, the use of a lukewarm bath, and perhaps the administration of a few doses of one of the bromine salts. After the fever has terminated, the child begins to feel well with surprising promptness and manifests an inclination to play and a desire to get up. Unfortunately, the mistake is oftentimes made of allowing it to do so. The patient should be kept in bed for at least a fortnight after the fever has disappeared, for during this time disintegration and absorption of the products of inflammation are going on in the cord. The completeness of this absorption has a bearing upon the degree of recovery. During this time the avenues of elimination from the body should be mildly stimulated, the patient's digestion and assimilation carefully attended to, and medicines that are known to have the property of facilitating absorption, particularly iodide of potassium, should be administered in small doses. Ergot and its derivatives were recommended by the older writers, and faithfully copied by many of their successors. Although willing to admit that there are theoretical indications for its use in the very beginning of poliomyelitis, I am fully convinced of its uselessness as a therapeutic agent after the inflammatory process has begun to subside. Furthermore, its administration after this period is quite as likely to do harm as good, and mention is made of it here only to advise against its use. During this stage, when the inflammatory focus can be accurately localized in the cord, mild counter-irritation over the spinal column at a level corresponding to the seat of the disease may be used both in the child and in the adult, always bearing in mind that infants are very sensitive to such a procedure.

Treatment of the Early Consequences of the Disease.—After from two to four weeks treatment directed toward counteracting the atrophy of the muscles and toward improving the nutrition of the paralyzed parts should be undertaken. The most valuable agencies for this purpose are electricity, massage, local warmth, and exercise. Electricity is used in poliomyelitis with two objects: First, and least important, to influence the circulation of the blood and lymph through the focus of disease and thus to contribute to its recovery; and second, to stimulate the peripheral neuromuscular apparatus to prevent inactivity atrophy and to increase the nutrition and volume of the fibres in the atrophic muscle that are not destroyed. The first indication is met by the use of

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... be very long before
...t objection on the
... the current should be

regulated by the feelings of the patient and the apparent effect that it produces.

Light massage may be instituted soon after the febrile period is passed. It should consist of mild kneading and pinching of the atrophied parts, followed by friction and percussion to influence the circulation. Its utilization should be accompanied by gymnastics given according to the Swedish method, the object being to give the diseased muscle, as well as the muscles that are functional antagonists of it, exercise and so prevent the one from undergoing changes the result of inactivity, and the other the result of unopposed action; in brief, the Swedish movements are thus passive and active, the patient resists the movements caused by the operator, and at the same time indulges in voluntary movements which the operator resists. Massage and resistance exercise should, like electricity, be kept up for a prolonged time, and they may be utilized simultaneously, or courses of the one and then of the other taken in succession. In large cities it is usually possible and always advisable to send the patient to an institution or gymnasium where these measures are scientifically and methodically carried out.

An important adjuvant to thwart the progress of the atrophy in a member is local heat. The surface temperature of the paralyzed extremity is usually from one to two degrees lower than the unaffected, and the limb is cold, objectively and subjectively. The patient should always wear flannel underclothing and stockings, and at night should have hot-water bags, hot-water bottles, a soapstone, or some other substance that retains heat for a long time in apposition to the withered extremity. During the day it should be plunged in hot water, once or twice, and oftener if convenient. Other means of adding to the local temperature and stimulating the circulation will suggest themselves to every physician to meet the indications in a given case.

The fact that the patient's limbs are incapacitated prevents him from play, getting about in the open air, and from taking exercise, which are so necessary for the maintenance of a high degree of bodily tone and nutrition. These must be substituted so far as possible by the utilization of baths and douches which have a tonic effect, attention to digestion and elimination, by an abundance of fresh air during the day and night, by regulation of time devoted to rest and sleep, and, in brief, by attention to the patient's general hygiene. Just how much effect strychnine has in counteracting the atrophy of the muscle cannot be estimated. There seems to be a consensus of opinion that it has some. It may be given internally with quite as much benefit as subcutaneously. Its administration should not be begun before all inflammatory phenomena have subsided. Its usefulness is probably dependent on its qualities to stimulate nutrition through the sympathetic nerves.

Treatment of the Remote Effects of the Disease.—The fourth indica-

...formities that are so apt to follow the occur-
... the co-operation of the orthopædic sur-
... occurrence. It may be taken for granted
... extensive as to result in a uniformly withered
... remote consequence of the disease, and
... be on guard to prevent it. The com-
... deformity are some variety of club-foot,
... When the patient begins to walk around
... foot naturally drops and if the extensor
... the unopposed flexor muscles produce
... in the beginning, is soon fixed and
... hillis and forcible breaking up of ad-
... apparatus can be applied. If, however,
... hyperextension, by means of a
... a simple apparatus consisting of
... around the ball of the foot, con-
... a rubber band, or any contri-
... be obviated. The principle
... apparatus in poliomyelitis after
... the deformity which re-
... opposed to those that are
... apparatus having for its pur-
... the use of a limb must be
... great usefulness and are
... presuppose sound limbs.
... It is impossible to state
... that will be required in
... and degree of atrophy
...
... to early tenotomy of the
... capacitating deformities can
... of the contracted
... nutrition of the para-
... movements of the parts
... permits. It is not
... tomies. Oftentimes
... adaptation of de-

... after an attack of
... compensatory. If
... tendency for him to
... this he at first
... the opposite side.
... gous manner the

spinal deformity in the lumbar region known as saddle back develops when the muscles on the anterior surface of the thigh are affected. These deformities rarely require any orthopædic appliance if they are counteracted early by appropriate gymnastics. As a matter of fact, nowadays, when a department of gymastics is an essential feature of every institution devoted to the treatment of the crippled, these deformities are not nearly so common among the poor as they were in former times. The utilization of gymnastic exercises requires a teacher of experience. There is no difficulty in finding such persons in every city, even though it be a rather small one. If it be impossible to secure the services of such a one, then some member of the family should make a pilgrimage to a teacher of gymnastics, and then utilize the knowledge acquired for the benefit of the patient.

Many surgical procedures have been suggested to overcome the condition known as flail joint, which occurs in the articulation of an extremity that has been withered by poliomyelitis. In some cases it may seem advisable to perform arthrodesis, that is, to cause artificial ankylosis, in order that the patient may have a firm basis of support. For instance, if the ankle-joint is so devoid of its muscular and ligamentous support that the foot wobbles about in every direction, the artificial ankylosation of this joint may give the patient a useful extremity. Naturally, an operation of this sort should not be undertaken by the general practitioner, and therefore specific directions are not given here. It must suffice to call attention to the occasional necessity for its production.

Another surgical procedure that is sometimes used to much advantage is tendon grafting, or "function transference," which was proposed by Nicoladoni in 1882, and which has since been done quite extensively. The end in view is to attach or graft on to paralyzed muscles the tendon of a neighboring healthy muscle. The technique of the operation will vary, of course, with the muscles paralyzed. Therefore each case requires separate consideration and ingenuity. If, for instance, the shoulder and upper arm muscles are involved in the atrophy of poliomyelitis, the patient may be entirely devoid of the power of flexion and supination of the forearm. In such cases it is proposed and has been accomplished to cut the tendon of the biceps and to implant it in the muscles of the forearm lower down. The *sine qua non* of its performance is that the muscle or group of muscles to which it is attached must be possessed of a fair amount of power in order that the requisite force may be obtained. The muscle that is functionally most nearly allied to the paralyzed one should be selected. Eve has shown that in some cases it is advisable that an antagonist of the paralyzed muscle be grafted with a view to weakening the action of the muscle whose unopposed contraction is causing the deformity. The method of uniting the tendons proposed by Goldthwaite seems to have found most favor. It consists in splitting

longitudinally with a tenotomy knife the tendons of the paralyzed muscle, and drawing the divided tendon of the functioning muscle through the hole just made, union being affected by a few sutures passed through the tendon.

Determined use of these various measures will contribute to such restoration of function, and so facilitate the unfortunate patient's recovery from this distressing disease that he may earn a livelihood and partake of many of the pleasures of his healthy brother.

(2) Bulbar Poliomyelitis. Acute Bulbar Myelitis.

Acute bulbar paralysis depending upon inflammation of the ventral gray matter of the oblongata is the distinct analogue of anterior poliomyelitis, and the little that is known of its etiology corresponds most closely with the causation of the latter affection. Very few cases in which the diagnosis has been corroborated by autopsy have been recorded. In such, however, as well as in those whose recognition is based on clinical data, the disease seemed to occur in youth and in early life, following or coincident with some acute infectious disease, such as influenza, pneumonia, diphtheria, and dysentery. Alcohol and rheumatism have been predicated as causes by Leyden. Reinhold has reported a case of progressive bulbar paralysis in which acute inflammation of the gray matter of the oblongata supervened.

The symptoms of acute bulbar poliomyelitis seem to come on very abruptly, but on close investigation, as in acute poliomyelitis, it is found that prodromal symptoms, such as obscure sensations in the head, dizziness, vomiting, precordial distress and palpitation, and indefinable feeling of dread and exhaustion precede the real bulbar symptoms. As a rule, the onset of the disease is attended by the concomitants of acute infectious processes, such as rigors, shivering, acceleration of the pulse rate, and fever. These are quickly followed by nasal intonation, regurgitation of liquids through the nose on attempting to drink, increased difficulty of swallowing, exhaustive paroxysms of coughing, due to the passage of foreign matter into the glottis, paresis of the lingual and buccal musculature, weakness of the extremities, difficulty of breathing, attacks of suffocation, tachycardia, and syncopal attacks. Occasionally other cranial nerves, such as the sixth, are involved, and in one case reported the third was affected. This bespeaks an extension of the inflammation along the floor of the fourth ventricle into the pons, or a contemporaneous involvement of the two levels.

The course of the disease is uniformly progressive, usually terminating in death within the first week. I have seen one case recover. In the very acute forms obnubilation of the mental faculties and hebetude which leads to coma go hand-in-hand with the development of paralytic

symptoms. A subacute form similar to the subacute variety of anterior poliomyelitis sometimes occurs.

Considering what has been said concerning the course of this variety of inflammation of the central gray matter, treatment does not count for anything. Occasionally in the subacute variety life may be spared for a long time. The general indications for treatment do not differ from those of bulbar apoplexy and those applicable to anterior poliomyelitis. The essential things to keep in mind are to search for the cause of the condition, and to take measures to overcome it. After that, the local application of ice combined with measures that contribute to obtaining rest and quiet fulfil the immediate indications. Urgent symptoms, such as syncope, may be somewhat ameliorated by the administration of diffusible stimulants and by the application of cold to the extremities, but as a rule they are of no service. The greatest care should be taken in feeding the patient. It is absolutely necessary to give nourishment exclusively by the rectum until after the acute symptoms have subsided. If the patient survives the acute manifestations, the treatment does not differ from that applicable to degenerative bulbar paralysis.

(3) Acute Superior Polioencephalitis (Acute Nuclear Ophthalmoplegia).

This is a form of ophthalmoplegia dependent upon an acute hemorrhagic inflammation of the central gray matter in the floor of the third ventricle, and the aqueduct of Sylvius. It has previously been said that pathologically it is analogous to the acute hemorrhagic form of encephalitis, polioencephalomyelitis, and acute poliomyelitis. It was first described by Wernicke in 1881. He based the description and the endeavor to establish the disease as a clinical entity on three cases, in which after death, a termination quickly reached, acute hemorrhagic and inflammatory destruction was found in the gray matter around the third ventricle. For a number of years after Wernicke gave a description of these cases observations by other clinicists were very few, but in all the cases it was pointed out that the disease seemed to have but one causation—alcoholism—and one termination—death. Latterly, other cases have been reported which, although they do not bespeak the frequent occurrence of the disease, show that the original claims in regard to the pathogeny and termination of the disease are without foundation. Cases reported by Uthoff, Salomonsohn, Wolfe, and others show that the disease may occur in those who are abstainers from alcohol, while the report of the latter as well as those of Thomsen, Werner, Boedecker, and Herrnheeser show that the disease may terminate in complete recovery.

It would now seem to be quite well established that next to chronic alcoholism the same acute infectious process that causes acute hemor-

rhagic encephalitis, viz., influenza, is oftenest responsible for this disease. It occurs also occasionally in the wake of pneumonia and diphtheria. Some writers would have us believe that the disease is a complication of alcoholic polyneuritis, but this view cannot be sustained. It has been observed after poisoning by lead, oxide of carbon, and sulphuric acid. It one case the only attributable cause was severe fright.

The hemorrhagic inflammatory process on which the disease is dependent need by no means be confined strictly to the central gray matter in the floor of the third ventricle and the aqueduct of Sylvius. It may extend through the pons, the cerebral peduncle, and the basal ganglia in an irregular way, or it may be associated with manifestations of inflammatory involvement in other levels of the cerebrospinal system. On the other hand, there are certain cases that have a very similar symptomatology, but are of less acute onset and intensity, in which after death no lesions are found. These cases are to be considered as analogues of asthenic bulbar paralysis (bulbar paralysis without anatomical foundation) in which it is supposed several levels of the different segments of the central nervous system are so overwhelmed by some toxic agency that they become functionless to a certain degree, and occasionally totally so. It is supposed that the injurious agency, whatever it may be, is not of sufficient severity to cause discernible morbid changes in the cells.

The symptoms of acute nuclear ophthalmoplegia consist of vertigo, headache, diplopia, uncertainty of gait, somnolency, mental torpor, which is often the predecessor of delirium; within from twenty-four to forty-eight hours there develop partial or complete ptosis, internal convergence or fixity of the eyeballs, and a whimpering, pathetic facial expression. Ophthalmoscopic examination often reveals a degree of optic neuritis. In some cases there is profound ataxia and marked difficulty of speech. The psychical manifestations are very similar to those occurring in alcoholic multiple neuritis.

The general measures to be adopted in the treatment are the same as those applicable in acute encephalitis. It is only in the cases following influenza and other infectious processes that any hope of recovery can be held out. In these it is not possible to say how much treatment contributes to that end. An insidious onset, a subacute course, and the absence of subnormal temperature are symptoms that point to a favorable outcome; an abrupt onset, a bizarre course, and subnormal temperature, even without an alcoholic history (which always predicates dissolution) indicate a most grave prognosis. When the disease passes into a chronic state, the treatment is the same as that described under chronic nuclear ophthalmoplegia.

(4) Acute Inferior Polioencephalitis.

It has been said above that the pathological process in acute superior polioencephalitis does not always confine itself to the gray matter around the third ventricle; it may extend in this substance beyond the aqueduct of Sylvius to the fourth ventricle, and even to the cord. The clinical picture will vary, depending on the level of the lesion and upon its extent, according as it involves groups of ganglionic cells which are the nuclei of origin of the cranial nerves. We have seen that when the lesion is confined to the gray matter of the third ventricle, the third, fourth, and sixth nerves are involved, and the pathological condition is known as superior polioencephalitis. When the inflammatory process is limited to the gray matter caudad of this level to involve the nuclei of origin of the tenth and twelfth nerves, the condition is called superior polioencephalitis. These two conditions not infrequently exist together, and the resulting clinical syndrome is that of superior polioencephalitis, plus bulbar symptoms due to implication of the upper bulbar nuclei. When these two conditions exist simultaneously the prognosis is extremely grave, but cases of recovery have been reported by Uthoff, Oppenheim, Gayet, and others. When the pathological process is so extensive that it reaches into the cord, the name of polioencephalomyelitis is given to it. A much larger number of such cases have been reported than of superior or inferior polioencephalitis alone.

In cases of inferior polioencephalitis the external muscles of the eye are first involved, but this is soon followed by symptoms of bulbar implication, such as immobility of the tongue, paralysis in the domain of the seventh nerve, defective innervation of the soft palate, difficulty of swallowing, attacks of dyspnœa, and tachycardia. The disease may run a febrile or an afebrile course.

The treatment of this condition is not different from that of superior polioencephalitis.

CHAPTER XV.

THE TREATMENT OF THE PROGRESSIVE MUSCULAR ATROPHIES OF CENTRAL ORIGIN.

Progressive muscular atrophy is the name given to a progressive wasting beginning in certain muscles or groups of muscles and extending to different parts of the body until it finally ends in death, either from marasmus or by the involvement of muscles whose activity is necessary for the performance of vital functions. The atrophy is dependent upon degenerative changes in the nerve cells of the ventral part of the cerebrospinal axis. The clinical form which the atrophy takes depends upon the groups of cells that are diseased, and upon the levels at which they are affected. The three most common seats of the disease are the cervical cord, the oblongata, and the pons. Gradual decay of the cells in each of these regions produces respectively the symptom complexes characterizing: (1) Spinal progressive muscular atrophy (the so-called Aran-Duchenne type of the disease); (2) progressive bulbar paralysis, or glosso-labio-laryngeal paralysis; and (3) progressive ophthalmoplegia, or gradual wasting of the musculature of the motor oculi nerve. These three varieties of progressive muscular atrophy are attended by the occurrence of individual symptoms which give rise to three distinct clinical pictures. In treatises on neurology they are considered as three distinct diseases. So far as they are known, the pathogenesis, causation, clinical accompaniments, course, and termination are the same in each one; and for this reason I shall consider them together. They are neuronic diseases in the strictest sense of the word, that is, the morbid condition underlying them is a progressive, gradual decay of the peripheral motor neurons, starting in the cell body or in the dendrites of the cells in the ventral part of the cerebrospinal axis, and extending throughout the neuraxons or axis cylinders to the actively contractile part of the muscular substance in which the neuraxons terminate. In other words, the spinal progressive muscular atrophies are chronic degenerative diseases of the peripheral motor neurons, with primary involvement of the cell bodies. There may be as many clinical types as there are groups of cells or functionally associated groups of cells in the cerebrospinal axis. Although the ventral cells of the cervical enlargement, the oblongata and the pons, are most frequently the seat of this degenerative disease, either singly or collectively, not infrequently, compared with the occurrence of any one of them, the cells of the lumbar or lumbo-sacral cord are diseased, giving

rise to a clinical type of the atrophy which corresponds to the cells involved.

When the morbid process affects simultaneously the cell bodies of the peripheral motor neurons in the ventral horn and the terminal arborization of the central motor neurons (in other words, the endings of the neuraxons that come down through the cord as pyramidal tracts), the degeneration extends centrifugally in the peripheral motor neurons, and centrifugally and centripetally in the central motor neurons, to constitute anatomically a destruction of the cells of the anterior horn and a degeneration of the pyramidal tracts. This process may develop in any part of the spinal cord, but the location that it has special affinity for is the cervical region. The process usually extends from here into the oblongata and occasionally in the pons and farther toward the origin of the pyramidal projection. This morbid condition gives rise to progressive muscular atrophy, that has a distribution entirely parallel to other forms of progressive muscular atrophy dependent upon lesion of similar cells in the ventral horn, but in addition and owing to involvement of the pyramidal tracts (which involvement is not sufficiently severe to cause complete impairment of their conductivity) it gives rise to the phenomena of spasticity. The disease, therefore, which this lesion causes is a progressive muscular atrophy plus spasticity of variable degree. Because of the fact that it depends upon lesion of the anterior trophic gray matter of the cord and the lateral conducting white matter of the cord, it is known as amyotrophic lateral sclerosis. Without entering into any discussion as to whether or not amyotrophic lateral sclerosis is entitled to separate nosological consideration, I shall discuss its treatment under the general heading of progressive muscular atrophies, but at the same time state what is known concerning its etiology apart from these conditions.

The progressive muscular atrophies occur under two very different auspices: (1) An acquired form; and (2) a family form. The truth of this statement has but recently dawned upon the profession. Formerly it was believed that the progressive muscular atrophies were acquired or accidental diseases. Then an hereditary form of spinal progressive muscular atrophy was described; a familiary form of bulbar paralysis and of ophthalmoplegia, and finally a familiary form of spinal progressive muscular atrophy. Gradually, however, it has become apparent that the columns of motor cells in the ventral portion of the cerebrospinal axis may be so defectively developed, or immaturely constituted the result of heredity, that they die in certain levels at variable times after the birth of the individual, varying from the first month up to the age of late maturity. When the cells of the lumbar enlargement die in early infancy and in more than one member of the family, we call the disease a family type of spinal progressive muscular atrophy, and the same when the cells of the cervical enlargement are diseased. Under similar circumstances,

when the cells of the oblongata disappear, we call it the family type of progressive bulbar paralysis; and when the cells of the ocular nerves atrophy, under similar circumstances, we speak of the clinical manifestations as a family form of ophthalmoplegia. In a treatise of this kind it is impossible to speak of all the clinical varieties of the progressive muscular atrophies in detail, so after these introductory remarks I shall discuss only the more important etiological features, and the treatment of the different clinical types.

(1) Acquired Spinal Progressive Muscular Atrophy (Type Aran-Duchenne).

Before the recognition of syringomyelia, localized hæmatomyelia and chronic poliomyelitis, and before the time that intraspinal tumors were differentiated, it was believed that this variety of progressive muscular atrophy was much more common than it is now known to be. That it is the rarest of spinal-cord diseases is conceded by all. Few, if any, have shown a willingness to follow the lead of Marie, who states that the disease has in reality no existence; for after all of the conditions that are capable of giving rise to a similar symptom complex are excluded, there still remains a small number of cases in which the diagnosis of progressive muscular atrophy due to destruction of certain groups of cells in the ventral spinal cord must be made. The symptoms that attend the development of such decay in these cells will depend upon the groups of cells involved and upon the severity of the morbid process. It has previously been said that the disease is primarily located in the majority of cases in the lower cervical region. This causes an atrophy of the muscles of the hand, principally of the interossei, the thenar and hypothenar eminences, which allows the hand to assume gradually a typical claw-like appearance. The atrophy extends to involve the muscles of the forearm, the shoulder girdle and arm, and, later still, the musculature innervated by the motor cells of the oblongata. The atrophy may finally involve the trunk and lower extremities, pointing to the implication of corresponding cornual cells. The muscular atrophy is attended by fibrillary twitchings, which are severe in proportion to the severity of the trophic process. The unopposed muscles pass into a state of more or less contracture, depending upon the rapidity of the atrophy in the affected part, and there is functional inability of a part or an extremity proportionate to the degree and extent of the contracture. If the trophic process is a rapid one, there is true reaction of degeneration to the faradic and galvanic currents in the neuromuscular apparatus; but if it is slow and insinuating, as it is usually, the electrical reactions are quantitatively diminished, or there is only partial reaction of degeneration. There are no other symptom

save those attributable to and dependent upon the depreciation of vitality and nutrition which are coexistent with the disease. These, however, are oftentimes pronounced and are the only ones that are at all amenable to treatment.

The course of the disease is progressive, but not uniformly so. It develops in an insinuating way, and continues by irregular exacerbations until it renders the parts absolutely functionless. Then the force of the disease seems to be spent, but after a variable time evidences of involvement of contiguous or remote groups of cells appear, and the symptoms thus induced continue until the respective part becomes useless. All this time the vitality is getting gradually impaired, until finally through a continuance of this, or through the appearance of the disease in muscles the functioning of which is necessary that vital processes may go on, the patient succumbs.

Etiology.—The causes of this variety of the disease are unknown. It occurs more often in men than in women, and especially during the years of mature adult life. It is rarely seen in any other classes than laborers and artisans. It has been attributed to recent and remote injury, both of the parts that show the atrophy and of the spinal cord; but it is unlikely that trauma has any determining influence, nor has exposure to cold. On the other hand, the relationship of occupation to the occurrence of the disease is a well-established one, and theoretically we can assume that there is an exhaustion of the peripheral neurons supplying the musculature that is put to excessive activity in smiths, polishers, embroiderers, etc. The occurrence of the disease has likewise relationship to the infectious fevers and to some of the metallic poisons, especially lead. Syphilis plays no rôle in the causation of the disease, nor does heredity.

Treatment.—The treatment of acquired spinal muscular atrophy is a very forlorn chapter in therapeutics. There is an impression abroad that the disease can be brought to a standstill by the use of strychnine given hypodermically in large doses. To a certain extent my own experience corroborates this view. I have had under observation for the past eight years a patient in whom the atrophy seems to have come and remained at a standstill after such treatment, combined with the use of faradic electricity, massage, and general hygienic measures. I have treated two other patients in the same way with encouraging results. But it has failed me in several other cases. The suggestion to use strychnine emanated from Gowers, and he is more enthusiastic in its recommendation than almost any other writer. The nitrate is the preferable salt to use, and it should be given in from one-eightieth to one-sixtieth of a grain, and gradually increased until the dose is brought up to from one-sixteenth to one-eighth of a grain, depending upon the results which attends its administration, and continued for a period of from two to four months.

If symptoms of improvement do not follow such a trial it should be discarded, except as it may be used to meet certain symptomatic indications. Apart from this, nothing has been recommended that approaches specific medication. The most important measures in the treatment are rest of the muscles that are beginning to atrophy, the use of electricity and massage to prevent the superimposition of inactivity atrophy, and the maintenance of a high degree of nutrition by regulation of the diet, exercise, hygiene, rest, and sleep, and the general state of the patient's bodily and mental health. So far as the causal therapy is concerned, it goes without saying that there should be at once a cessation of the occupation under the auspices of which the disease developed, and if any relationship can be traced between infectious diseases or intoxications and the occurrence of the disease, medicinal measures taken to counteract and overcome them. The uselessness of electricity and massage in the treatment of progressive muscular atrophy is unswervingly contended for by some, but it is the experience of most physicians and my own that when used with great moderation they are agencies of considerable value in delaying the progress of the disease. Massage is more serviceable than electricity. In using massage, only the gentlest kneading movements should be employed. A very weak faradic current should be applied daily to the affected muscles for about five minutes. The danger is that too strong a current will be used. If the faradic current does not cause any response, the galvanic current should be used, both to redden the skin and to cause very slight contraction in the muscles. To maintain the general nutrition, use must be made of mild forms of tonic hydrotherapy, of exercise, of tonifying medicines, such as arsenic, iron, small doses of mercury, and iodide of potassium. The animal extracts have been recommended, particularly extract of the thyroid gland, but the published experience seems to be decidedly against it. Change of climate, visitation of the different health resorts, and sea voyages, all of which are not infrequently advised, are serviceless, save as they may contribute to the maintenance of the patient's morale and courage. Unlike its opposite tabes, or progressive degeneration of the peripheral sensory neuron, whose progress is almost invariably hindered by persistent, indefatigable treatment, progressive muscular atrophy is not infrequently ameliorated by anything approaching active treatment. It remains to be said, therefore, that the results of treatment should be carefully watched, and if the disease is progressing all attempts at treatment directed specifically to the atrophic process interdicted, while the therapeutic efforts are centred in maintaining the general health.

The family type of spinal progressive muscular atrophy is referred to here merely for the sake of completeness. So far, no therapeutic measure has been suggested that has the slightest effect in staying or modifying the course of the disease. Clinically, there are two types of this af-

fection, one that corresponds in the distribution of the muscular atrophy with the Aran-Duchenne type, and secondly, the more frequent variety apparently, in which the muscular atrophy begins in the muscles of the lumbo-abdominal girdle, and successively involves those of the hips, the thighs, and the legs. The disease is characterized by its beginning in infancy or early childhood; by its manifestation in more than one member of the same family; by its progressive course; by the symmetrical location of the atrophy; and by the absence of any other symptoms than those due to the decay of the peripheral motor neuron. The disease ends fatally in from one to three years.

(2) Chronic Progressive Bulbar Paralysis (Labio-Glosso-Laryngeal Paralysis).

Clinically this disease consists, as its name implies, of a paralysis of the lips, tongue, and larynx, causing a destruction of some or all of the functions of these parts, associated with atrophy, particularly of the lips and tongue. Anatomically it is dependent upon a progressive atrophy of the motor nuclei in the ventral portion of the oblongata. The clinical phenomena of the disease are gradual disturbance of articulation, characterized by slowness and indistinctness; difficulty of mastication and of swallowing; in brief, difficulty in executing any of the movements subserved by the musculature supplied by the ninth, tenth, eleventh, and twelfth nerves. The inability to close the mouth and to pucker the lips gives to the lower half of the face a characteristic expression, while the atrophy of the lips and tongue, accompanied by fibrillary contractions, are apparent to the eye and to the touch. As the disease progresses, the manifestations of labial and lingual prehension, articulation, mastication, swallowing, and laryngeal activity become more and more impaired, while evidences of encroachment upon the lateral nucleus of the pneumogastric are manifest by attacks of cardiac palpitation and syncope. There are no sensory disturbances. The electrical excitability of the muscles is the same as in the spinal form of progressive muscular atrophy. The actual causes of the disease are unknown. Like in progressive spinal muscular atrophy, the disease occurs in individuals who have put the musculature supplied by the peripheral motor neurons of the oblongata to exhaustive use, and the degenerative changes in these neurons are the natural successors of exhaustion. Thus the disease has been observed in glass-blowers, buglers, and cornet-players. Progressive bulbar paralysis is a rare disease at any age and particularly so in the young, except the familiary form, which will be referred to later. Occasionally, it is seen in advanced life. The disease occurs about one-third more frequently in males than in females, and the cases observed in females develop at relatively a more advanced age. Factors which are

often held responsible as causative of degeneration in other parts of the nervous system, such as rheumatism, syphilis, and gout, cannot be posited as etiological factors in this disease, it being rare to find that the poison of these diseases has ever found tenancy in the system; nor can it be said that the disease is closely associated with degeneration of blood-vessels, aside from the fact that it commonly occurs at an epoch when arteriosclerosis usually take place.

The exciting causes are first and most important overexertion, particularly of the mouth and vocal apparatus, fright and anxiety, enervating habits, exposure to cold, and all forms of depraving influences. Theoretically, it is considered that toxic factors may be operative in some cases, but the only proof of such that can be advanced is one of analogy. In a few cases, however, it has been observed that the disease occurred after lead poisoning, diphtheria, and influenza. But in considering these cases it must be kept in mind that many of them were reported at a time when the symptom complex now described under bulbar neuritis was unknown. Occasionally degenerative bulbar palsy seems to develop secondarily to acute inflammatory bulbar paralysis, just as progressive muscular atrophy seems now and then to follow many years after a poliomyelitis of infancy. Not infrequently progressive bulbar palsy is merely an extension upward of the degenerative process that is at the bottom of spinal progressive muscular atrophy and amyotrophic lateral sclerosis. A gliomatosis of the central canal extending into the fourth ventricle and the development of a tumor in the oblongata may likewise cause the syndrome of bulbar palsy. Very rarely the formation of an islet of multiple sclerosis or a number of them in the ventral portion of the oblongata may cause the syndrome of this disease.

The duration of the disease is a very variable one. Some cases run a uniformly progressive course, and terminate fatally within one or two years. In other cases the course of the disease is characterized by periods of improvement, or at least by remission of some of the distressing symptoms. Such remissions are temporary, and have no influence to alter the eventual fatal outcome, although they may add to the patient's days and comfort. Very rarely, probably never, does the progress of the disease come to a standstill. The course is essentially chronic, and month after month the gradual increase in the intensity of the symptoms, notwithstanding the most assiduous treatment, is lamentable and discouraging. It is uncommon for the disease to take more than from three to four years to run its course, but occasionally it lasts more than twice that length of time. The immediate causes of death are universal exhaustion, death occurring from heart failure, attacks of syncope, or the pneumonia of swallowing; foreign substances, principally those taken for alimentation, pass into the larynx and into the respiratory passages and cause strangulation and suffocation, bronchopneumonia and localized pulmonary gangrene.

Treatment.—Although this disease leads uniformly to a termination which no therapy is able to avert, and although oftentimes our most strenuous efforts to delay the fatal outcome are negative, nevertheless, in the majority of cases, not only can the patient's comfort be contributed to, but his existence materially prolonged by assiduous and proper treatment. The real causation of the disease being unknown, it is impossible to speak of causal or prophylactic treatment other than to say that occupation or injurious indulgences that may possibly have any influence upon the disease should be interdicted and avoided. The most important factors in the treatment of chronic progressive bulbar paralysis are the maintenance of the patient's nutrition, and the securement of as nearly as possible complete rest to the muscles that are undergoing atrophy. A semisolid and liquid diet should be adopted from the beginning, and this of the most nourishing kind. Milk and its various preparations, eggs, raw or slightly boiled, the most concentrated meat soups and nourishing gruels, should form the principal part of the dietary. The amount of force required to masticate and swallow meat and the consequent exhaustion more than counterbalance any benefits to be derived from it. The proteids, although important energizing agents and tissue builders, are not so urgently required as to warrant giving them in the shape of meat that must be chewed and swallowed. Proteids that admit of being given in liquid or in semisolid form fulfil every requirement. Careful diet lists should be prepared and the form of food changed with sufficient frequency to prevent the patient from tiring of it. It is a mistake to consider that a larger amount of food than is necessary to keep up the patient's weight is of any considerable benefit. It is advisable to remove dry bread-stuffs early from the dietary, as they are most liable to enter the glottis and provoke severe attacks of spasmodic coughing. Semisolids are swallowed with greater ease than liquids. As soon as swallowing becomes especially difficult, resort should be had to the feeding tube. The diminished sensibility of the palate and vault of the pharynx which these patients have during the later stages of the disease contributes to the ease and comfort with which the tube can be passed. It cannot be too strongly emphasized that this mode of feeding should not be left until the patient is absolutely incapable of making deglutatory efforts. This mode of feeding may often be supplemented by limited rectal alimentation. As a rule, all forms of alcoholic drinks are harmful in this disease. Their ingestion tends not alone to make the patient more uncomfortable by contributing to palpitation of the heart and flushings, but they have a depressing after-effect, which is materially bad. Any beneficial influence they have to stimulate the nutrition is easily obtained from the administration of a mildly alcoholic or non-alcoholic malt extract. The same may be said of tea and coffee; cacao, however, is a nutriment of real value. The patient should be prevented from using his voice with the same scrupulousness as in

pneumonia. The early formation of the habit of communicating desires and thoughts graphically can only be advantageous and it is to be commended. Feeble efforts to dislodge food that gets between the teeth and cheeks by the tongue, as well as all other unnecessary movements performed by the labio-glosso-laryngeal musculature, are to be deprecated.

The two therapeutic measures which can be made use of by the physician with the best prospects of affording some relief are electricity and strychnine. Various ways of applying the former have been advised. Personally, I believe that any benefit to be derived from this procedure is obtained through its preservative influence on the degenerating muscles, and not in any way on the degenerative process in the oblongata. Therefore, passing the galvanic current from one mastoid process to another, or galvanization of the cervical vertebral column, is not advocated. The use of the constant current to cause slight contraction of the muscles of the face, tongue, lips, and pharyngeal muscles, and to cause artificial swallowing movements for a few minutes each day, is the electrical procedure that is advised. As in all such degenerations, the danger is that too much rather than too little electricity will be given. By this I do not mean to convey that electricity is not of real service in delaying the progress of the atrophy, and particularly in facilitating ease of deglutition. The electrical treatment should be kept up every day for two months, each *séance* lasting for from five to ten minutes, and then an estimate taken of its effect. Particular warning must be given against the use of the galvanic current in this disease without a rheostat and milliamperemetre. The patient's comfort and well-being are frequently contributed to by a moderate amount of general faradization, and by the use of massage. I have never been able to convince myself that massage of the atrophying parts was of the slightest service, but general massage, if given with sufficient mildness, may exercise a tonifying effect on the nutrition. Although the beneficial effects of strychnine are never so apparent in this disease as they are occasionally in its analogue, progressive muscular atrophy of spinal origin, yet it is the most satisfactory vascular and muscular tonic available in chronic progressive bulbar palsy. It should not be given hypodermically. In many cases it can be advantageously combined with small doses of morphine, especially when the patient complains of dyspnœa. The morphine, given in from one-thirtieth to one-fifteenth of a grain twice a day, acts as a reliable cardiac stimulant, while it exercises a soothing effect upon the patient's mind. The latter effect is well manifest in the relief of the dyspnœa, which is almost always partly psychical. The use of iodide of potassium, mercury, and the salicylates, with the idea of specific and alterative action, as has been recommended by some writers, is a fallacy. Unless a history of comparatively recent syphilis or rheumatism can be obtained, or unless there are other reasons for suspecting these diseases, such drugs are harmful.

Nitrate of silver, phosphate of zinc, and ergot, have been used extensively, but they cannot be recommended.

Aside from steadying the nutritive balance by restoratives and aids to digestion and guarding the patient against factors that produce excitement or depression, the treatment is symptomatic. The patient should lead a quiet, uneventful life, as free as possible from strife, worry, and anxiety. Exercise in the open air, in moderation, is essential, but care is to be taken that it is not carried to the point of fatigue. The utilization of an occasional course of mild cold-water treatment for its tonifying effects and to keep up the patient's general nutrition is advisable. The symptoms that not infrequently require particular treatment are drooling, coughing, dyspnœa, syncope, cardiac palpitation, and hysterical types. Drooling is not so common a symptom as might be inferred from reading some of the older authors, but occasionally it is not only depressing and exhausting to the patient, but very annoying to those about him. It is but slightly influenced by belladonna and its alkaloid, or by any other medication save morphine. As it is not advisable to give the latter in quantities sufficient to affect the secretion, the drooling must be combated by absolute quiet of the patient. When, however, it seems to be very exhausting, no hesitation should be had in the use of morphine for a few doses. Attacks of spasmodic coughing and which are usually due to the entrance of foreign particles into the air passage, owing to incomplete closure of the glottis, are oftentimes a most annoying and exhausting symptom. It can be relieved temporarily by the administration of medicines that tend to blunt the sensation of the larynx, such as the bromides and morphine. But there is some danger in using these substances. The spasmodic cough is nature's signal that foreign substances are attempting to enter the respiratory passages. If the sensibility of the laryngeal mucous membrane is blunted, the entrance of such foreign substances may be unsignalled, and lead up to the occurrence of "swallowing" pneumonia. Despite this, small doses of morphine or cocaine must oftentimes be used to combat the symptoms, but during their administration extra caution must be had in the feeding of the patient.

Dyspnœa, syncope, and cardiac palpitation are all in the beginning of the disease partly psychical, and more may be accomplished for their amelioration by suggestion and by assurance that these symptoms are of no portentousness or significance than by the administration of drugs. However, the effects of a cold-water compress over the heart, the administration of a pungent aromatic cardiac stimulant, such as ammonia or ether, may be partly psychical as well as physical, and beneficial for both reasons. Hysterical attacks superimposed upon bulbar palsy are most distressing to witness, and extremely exhausting to experience. The treatment that is applicable for them does not differ from that which is serviceable in hysterical attacks occurring without organic disease. It

has not seemed to me that the hysterical attacks have added to the gravity of the disease in two patients with chronic bulbar progressive paralysis who have been for a number of years under observation.

If paralysis of the vocal cords or the entrance of foreign substances into the respiratory passages makes suffocation imminent, one should not hesitate to perform tracheotomy.

Family Form of Chronic Progressive Bulbar Paralysis.—The familiary or hereditary variety of chronic progressive bulbar paralysis is of comparatively recent recognition. It is apparently very infrequent, even compared with the variety just described. It occurs under practically the same conditions as the infantile and familiary forms of spinal progressive muscular atrophy. It occurs in infancy and during the developmental years of life, and has no particular symptomatic features, aside from the ordinary form, save a participation in the atrophy and paralysis of the upper facial musculature. This is especially true of the cases of familiary bulbar paralysis detected in infancy. Familiary bulbar paralysis in the adult would seem to be unattended with involvement of the upper facial, but it has the unusual complication of muscular atrophy, especially of the muscles of the neck. As in chronic degenerative progressive bulbar palsy, the disease is a progressive one toward a fatal ending, but the course of the disease is oftentimes very slow, from ten to twenty years elapsing before the termination. The course of the disease is apparently uninfluenced by treatment, save in general and symptomatic indications pointed out for the idiopathic form. These should be followed out as consistently as possible in this form. The infantile familiary variety is not infrequently superimposed upon the spinal variety of progressive muscular atrophy, or a forerunner of the former, and the treatment for the one is likewise the treatment for the other.

Asthenic Bulbar Paralysis.

Asthenic bulbar paralysis, myasthenia gravis pseudo-paralytica, bulbar paralysis without anatomical foundation, are the designations given to a class of cases in which the symptoms in their entirety resemble very closely chronic degenerative bulbar palsy, and in which after death—a termination to which the majority lead after a variable time—examination of the motor neurons as well as of other systems of the body fails to reveal any striking departures from normal.

Nothing is known of the causation of the disease. Of the cases reported the majority have been under the age of thirty. It has been observed in a patient with profound chlorosis. The possibility that it is dependent upon a chronic intoxication of endogenous, or possibly of exogenous origin has been suggested. There is much in the irregular course of the disease as it manifests itself in some patients that lends color to

the view that it is dependent upon injurious agencies, the source of which is within the body.

The symptoms usually develop slowly. The patient may have complained for an indefinite time of easily induced fatigue and a feeling of overpowering exhaustion after comparatively slight effort. The development of the symptoms may, however, be rapid so that the disease reaches its height in a few weeks. Frequently the initial symptom that attracts the patient's attention is ptosis of one or both sides. The ptosis may appear first on one side, then disappear, and the upper lid of the opposite side becomes affected, or it may occur on both sides simultaneously and be associated with paresis of some muscles supplied by the oculomotor nerve, such as the internal or superior rectus. Following this, or going before, there occur weakness of the muscles of mastication, paresis of the lower part of the face, and defect in articulation and in vocalization, which is associated with paresis of the abductors and adductors of the vocal cords. The voice becomes nasal and talking tires the patient and quickly exhausts his capacity in this direction. The lips are unwieldy and there may or may not be paresis of the tongue; swallowing is difficult or impossible, fluids regurgitate, and the soft palate is lax and responds very sluggishly to mechanical irritation. General weakness with a feeling of exhaustion in the trunk and extremities, true amyosthenia of all the motor parts of the body develops symmetrically, at the same time with or after the bulbar symptoms. In exceptional cases the weakness manifests itself first in the arms, extends to the legs, and eventually shows itself in the cranial nerves. As the disease progresses, and this it may do with considerable rapidity, respiratory and cardiac symptoms become very distressing and foreshadow dissolution. The course of the disease is irregular, made up of periods of remission and improvement and of periods in which the functions of the motor and sympathetic nervous systems are profoundly impaired. The manifestations through the sympathetic nervous system are practically those of shock and they are irregularly periodic in occurrence.

In contrast to true bulbar palsy the muscles preserve their volume, at least there is no true degenerative atrophy. Electrical irritability of the neuromuscular apparatus is preserved, but frequently exhausted after brief excitation, and irritability is not regained until after prolonged rest. There are no fibrillary twitchings of the muscles of the face and extremities, and the deep reflexes are present, but, like the electrical irritability of the muscles, their excitability is quickly exhausted and recovered only after rest. There are no disturbances of sensibility, either objective or subjective, and the special senses are unaffected, although all of them become speedily fatigued. Digestion is impaired and normal intestinal activity is handicapped by lack of muscular tone. There is no drooling; the sphincters are intact; and the psychical faculties are unimpaired.

The shortest duration of any recorded case is six months. I have had under almost daily observation a typical case for upward of five years. She is now nearer recovery than she has been at any time during this period.

Treatment.—Complete and absolute rest to all parts of the body, the eyes, the tongue, the throat, and the extremities, is the most important factor. Restoratives and the careful and judicious use of measures to maintain a high state of nutrition, while at the same time every precaution is taken to prevent unnecessary expenditure of energy and bodily waste, will be followed by the best results. Artificial feeding by means of the stomach tube should not be resorted to, as the movements of regurgitation caused by the passage of the tube are more exhausting to the patient than is the act of swallowing artificially masticated and liquid food. Oppenheim warns against the use of electricity for the purpose of causing muscular contraction, but recommends central galvanization. The usefulness of the latter has been corroborated by Goldflam, who reports the recovery of four patients. In the treatment of one of my own cases which has been very successful I employed central galvanization and the galvanic current to produce the weakest possible contraction of the muscles manifesting the asthenia.

If it is borne in mind that in this disease all the voluntary muscles, and especially the oblongata musculature, are in such a state that slight stimulation soon exhausts them, it will not be necessary to warn against the incautious use of strychnine, massage, and electricity, the three most available muscle tonics. All of these may be employed if intelligence directs their use. Strychnine should be given in extremely small doses, while its effects are carefully watched and the moment it produces any feelings comparable to fatigue and exhaustion after its physiological effects have worn off, the dose should be materially diminished. It is most useful when symptoms of inefficiency of the sympathetic nervous system are conspicuous. Another drug that I have used to good advantage under like auspices is the salicylate of physostigmine in from $\frac{1}{100}$ to $\frac{1}{40}$ grain doses. Massage and galvanic electricity may, I believe, be used to advantage if care and attention is given to their application, and if they are given in sufficiently small dosage.

(3) Chronic Progressive Ophthalmoplegia.

When the ganglion cells in the ventral portion of the pons undergo disease changes similar to those constituting the pathology of progressive muscular atrophy and progressive bulbar paralysis, the result clinically is bilateral atrophy and palsy of the external muscles of the eye, to which the name chronic progressive ophthalmoplegia is given. Like the other forms of progressive muscular atrophy, there are nosologically two varie-

ties—the hereditary infantile form and the acquired idiopathic form. The acquired variety is the more common. The pathological change underlying it is similar to that of chronic bulbar paralysis and chronic progressive muscular atrophy, and it may complicate or be complicated by either of these two conditions, particularly the former. The variety of bulbar paralysis that is associated with chronic progressive ophthalmoplegia, is, however, not so typical clinically as the uncomplicated variety. The same is true for progressive muscular atrophy of the Aran-Duchenne type. In other words, when the brunt of the lesion is borne by the cells of the pons and the oblongata, or the pons and the cervical cord, the resulting degeneration is neither so severe nor so extensive as it is when the pathological changes are confined exclusively to one of these segments. It would almost seem that the cause of the pathogenetic process when distributed over a larger area was insufficient to produce destruction of all the cells in a given area.

Chronic progressive ophthalmoplegia occurs under about the same auspices as the other two varieties of progressive muscular atrophy that have been described. It is most liable to develop in persons from twenty to forty years of age, and somewhat more often in males than in females. Intoxications and infections, as well as traumatism and exposure to cold, have been held responsible in some instances, but their relationship to this disease is no closer than is their relationship to the other progressive muscular atrophies. This, in truth, is very insignificant. It is more than likely that some of the cases that have been reported as occurring after diphtheria and poisoning by the minerals, such as lead, were dependent upon a rudimentary form of neuritis of the oculomotor nerve. It occasionally develops in syphilitic individuals who are benefited by the administration of antisyphilitic remedies, and thus this infection is considered of some causal importance. It is most commonly a complication or integral part of some other disease, such as general paresis, locomotor ataxia, multiple sclerosis, and the progressive muscular atrophies already mentioned.

The disease is evidenced clinically by the gradual and progressive occurrence of functional disability of the external muscles of the eyes which progresses until these muscles are completely powerless, usually associated with a slight or moderate degree of ptosis. The initial symptom is diplopia, but the patient soon unconsciously suppresses one of the images and depends upon monocular vision, so that after the disease has lasted for a time the patient does not complain of seeing double. The internal eye muscles are usually spared, but they may be involved to a considerable degree. The diagnosis can readily be made by process of exclusion.

The congenital variety is invariably associated with lack of development and functional incapacity of the facial nerve. This form of the

disease is akin to the familiary varieties of bulbar and spinal atrophy, that are supposed to be dependent upon incomplete development or atrophy of the respective nuclei. The course of the disease in this variety is apt to be more stationary and is sometimes associated with evidences of hypoplasia of other parts of the central nervous system.

Treatment.—Less can be done in the treatment of chronic progressive ophthalmoplegia than in any form of progressive muscular atrophy, and for the simple reason that we are unable to apply the measures, such as electricity, massage, and rest, that have some capacity to delay the progress of the atrophy in other varieties of progressive muscular atrophy. Unless there be some specific causation of the disease, such as syphilis or metallic intoxication, that allows of specific medication, efforts at treatment are limited to maintaining the general nutrition of the patient, and advising complete rest of the muscles involved. Strychnine does not seem to be of any use, except as a general tonic, nor do arsenic and iodide of potassium. When the disease occurs as a forerunner or concomitant of other diseases, such as have been mentioned, treatment must be directed toward opposing them.

4. Amyotrophic Lateral Sclerosis.

The nosological relationship of amyotrophic lateral sclerosis to the progressive muscular atrophies has already been spoken of. This disease is characterized by the symptoms of progressive muscular atrophy of the Aran-Duchenne type, complicated with bulbar involvement, plus spastic paresis, particularly of the lower extremities, and exaggeration of the tendon jerks all over the body. The symptoms of spasticity usually precede those of atrophy, and it is therefore believed that implication of the terminations of the central or cortico-motor neurons antedates that of the peripheral motor neurons. That this is so is shown not only by the occurrence of spastic symptoms before the trophic symptoms, but by the fact that when cases come to autopsy the morbid process in the central motor neurons gives every evidence of having been complete for some time, while that in the peripheral motor neurons is in progress. Although occasionally the disease is accompanied by pathological changes in other parts of the cord, such as degeneration of the posterior columns, as a rule the symptom complex does not include any disturbances of sensibility or of the cutaneous reflexes, or disturbance of the functions of the bladder or bowels. The absence of such symptoms bespeaks the limitation of the disease process to the anterior horns and pyramidal tracts.

The etiology of the disease is practically unknown. From analogy and from inference, particularly those based upon the findings in cases studied microscopically, it is believed that the anatomical basis of the disease is conditioned by some chronic intoxication acting through the vascular sys-

tem. The forces that determine the involvement of the terminations of the central motor neurons and the beginnings of the peripheral motor neurons can only be conjectured. Such injurious influences as hereditary disposition of ganglion cells in different parts of the cerebrospinal axis to undergo decay without adequate cause, manifested by the occurrence of nuclear or neuronic diseases in the collateral ancestry; exhausting overwork of the extremities; trauma to one of the extremities or to the spine; vascular depravity following repeated exposure to cold, intoxications and infections, may have this effect, but we cannot prove it. As a matter of fact infectious disease, syphilis, intoxications, cold, excesses, and the like, have apparently very little relationship to the occurrence of the disease. It occurs in males and females with equal frequency, and develops ordinarily between the thirtieth and fortieth year. Occasionally the onset of the disease is rather abrupt and the patient succumbs in from twelve to eighteen months. As a rule, however, symptoms develop insidiously and the course of the disease averages from two to three years.

There is a well-established familiary variety of amyotrophic lateral sclerosis, which like all other familiary disease of this class occurs in childhood and pursues a very chronic course, being oftentimes stationary for a number of years.

Treatment.—The treatment of amyotrophic lateral sclerosis is practically the same as that for chronic myelitis in addition to the general measures that are of service in maintaining the nutrition spoken of under spinal progressive muscular atrophy. No drug medication has the slightest effect upon the course of the disease. The intensity of the spasticity may be somewhat decreased, and the suffering engendered by this condition mitigated by the use of prolonged lukewarm baths, in which the patient may remain for from two to four hours out of the twenty-four. The crippling of the patient through the spasticity and contractures that occur in the unopposed muscles after atrophy has become well pronounced can be overcome to some extent by the persistent use of active and passive gymnastics, but oftentimes the annoyance and fatigue attending such indulgence more than counterbalance the slight beneficial effect. When the morbid process invades the oblongata, the symptoms of bulbar paralysis should be treated in the same way as has already been mentioned under that caption. The same care must be expended upon the feeding, and all that this implies, that is necessary in true bulbar paralysis. The entire treatment of amyotrophic lateral sclerosis may be summed up in a word: make the patient as comfortable as possible. For patients who can afford it, this is most satisfactorily accomplished by providing them an intelligent nurse. Those who cannot should seek the shelter and care of a hospital. Despite this gloomy view of the treatment of amyotrophic lateral sclerosis, the physician should not despair. It is not too sanguine to expect that nature has provided a remedy to check the disease if it can be found and

applied before the neural constituents, the decay of which forms the anatomical basis of the disease, have perished. This is surely true if the pathogeny of the disease is the result of some chronic intoxication. If the disease is a teratological defect, a disease of involution, it is idle to search for such a remedy.

The Treatment of Neural Progressive Muscular Atrophy.

(The Peroneal or Leg Type of Progressive Muscular Atrophy.)

This variety of progressive muscular atrophy has been studied especially by Charcot, Marie, and Tooth, and is not infrequently referred to by the names of one or all of these investigators. During the past few years it has received extensive consideration based upon close clinical and anatomical studies, both here and abroad, so that at the present time the clinical delineation is well known and the morbid processes upon which it is dependent bid fair to be satisfactorily elucidated, although at the present time they are not entirely so. After the disease was first described it was contended by many writers that the morbid process was predominantly, if not exclusively, a degeneration of the nerves with secondary involvement of the spinal cord, particularly the columns of Goll; but at the present time there can be no doubt that the so-called "neural form" of progressive muscular atrophy is dependent upon different anatomical processes. In some cases it is primarily a disease of the peripheral nerves, while in other cases it is just as certainly a primary myopathy. Furthermore, it is wholly probable that in some cases the pathological changes occur simultaneously in the spinal cord and peripheral nerves, or even primarily in the cord. The clinical picture of this variety of the disease, it may therefore be said, does not depend upon an individual pathologico-anatomical foundation.

The symptoms of the disease are, it may be readily inferred, subject to variation in kind, in intensity, and in course. As a rule, the muscular wasting begins in the musculature of the peroneal nerves, and is manifested by the gradual occurrence of club-foot. Occasionally, the atrophy shows itself first in the upper extremity, especially the small muscles of the hand and the extensors and flexors of the forearm. Wherever the primary manifestations of the atrophy may be, it may extend to any part of the body. In a case recently reported by Siemerling, in which the initial muscular atrophy was of the thighs and the hands, there eventually developed loss of the pupillary reaction, nasal speech, tremulous voice, in addition to an extreme degree of paretic atrophy of the forearms and entire lower extremity. The distinguishing clinical features between this form of progressive muscular atrophy and the spinal form are the sensory disturbances which are never absent, and the more complete reaction of

degeneration in the atrophied muscles to the electrical current. The causes of this disease, aside from the fact that it is a family affection, are entirely unknown. It usually begins during the early years of life, almost invariably before the age of puberty, and pursues an extremely chronic and irregular course. That there are exceptions to this rule is shown by the fact that Oppenheim and Cassirer have reported a patient in whom the disease began in the forty-second year, and Egger has described the disease as it occurred in two brothers, aged respectively thirty-three and thirty-eight years of age. The male sex is affected oftener than the female. The customary attributable exciting causes, such as exposure, intoxications by lead, alcohol, and syphilis, as well as the inherited diminished capacity of resistance of the nervous system, are spoken of in the etiology of the disease, but practically nothing is known of its real causation save that it is a family affair.

Treatment.—The treatment of this form of progressive muscular atrophy calls for the measures that have been enumerated in discussing the treatment of progressive muscular atrophy of spinal cord dependency and the progressive muscular dystrophies. The fact that all family nervous diseases pursue a much slower course and are oftentimes characterized by more or less prolonged cessation of the apparent activity of the disease, affords opportunity for the use of electricity, massage, and gymnastics looking toward the retardation of the morbid process and the changes in the muscles. The fact that the disease usually begins in the feet and the legs, causing some variety of club-foot which seriously cripples the patients, prevents them from getting the exercise and indulging in some of the pleasures of life that might otherwise be afforded. These deformities should be subjected to the same kind and grade of orthopædic treatment as similar deformities arising under other conditions.

CHAPTER XVI.

THE TREATMENT OF MUSCULAR DYSTROPHY.

The term muscular dystrophy is applied to that form of atrophy in which the primary changes are in the muscles themselves, in contradistinction to ordinary progressive muscular atrophy in which the atrophy is secondary to disease of the ventral horn cells of the spinal cord, or the peripheral motor nerves. Formerly the progressive muscular atrophies and dystrophies were not differentiated, but so soon as it began to be recognized that the former were almost invariably acquired diseases of adult life, and that the latter were either family or hereditary diseases, occurring in infancy and early adult life, the distinction began to be made. In latter years the tendency has been to draw the line of separation very closely, from an anatomical standpoint, between the progressive muscular atrophies and the dystrophies. The result is a more or less widely disseminated belief that in the dystrophies there are no pathological changes in the spinal cord. As a matter of fact, it is highly probable that in every case of the latter affection there are secondary changes throughout the entire peripheral motor neurons, especially after the disease has existed a long time.

Anatomically, the progressive muscular atrophies may be classified according to the segment of the peripheral motor neuron that is affected into myelopathies, neuropathies, and myopathies, according as the cell body, the neuraxon, or the intramuscular ending is primarily involved. In muscular dystrophy the lesion in the beginning is in the intramuscular nervous substance. The pathological changes that are found in the neuraxon and in the ventral horn cells are secondary and have nothing to do with causing the phenomena of the disease.

Formerly a number of clinical varieties of muscular dystrophy were described and much energy was devoted to the establishment of differentiations between the types; but to-day it is fully recognized that muscular dystrophy is a distinct disease subject to variations in the time of its development, in the groups of muscles which are affected, and, to a less important degree, in its clinical features. Separation of the clinical forms of the disease is of no service, save as it may facilitate prompt recognition of the disease and thus indirectly contribute to an estimation of the course and prognosis.

Many clinical types of progressive muscular dystrophy are described, but I shall refer only to the three important ones. These are: 1. Pseudo-hypertrophic paralysis, which occurs in early childhood, more often in males than in females, and which shows itself first in the lower extremities, especially the calves, by apparent hypertrophy of these and other groups of muscles, associated, however, with loss of strength. The enlargement of the muscles is due to a progressive lipomatosis which goes on at the expense of the muscular fibres and a myosclerosis. The disease then extends to the trunk, especially to the muscles of the sacro-lumbar region, and gives rise to a characteristic gait, station, and mode of assuming the erect posture from a recumbent one. Later the upper extremities become affected, especially the muscles of the shoulder girdle and upper arm, and as a rule these muscles atrophy without undergoing a preliminary spurious hypertrophy. The muscles of the forearm and face are spared until very late in the course of the disease. As the disease progresses, the apparently hypertrophic muscles shrink proportionately to the completeness of the fatty transformation and myosclerosis.

Leyden and Möbius individually called attention to a form of muscular atrophy that resembles this type in every respect save that the dystrophy is not attended with any considerable pseudohypertrophy. Some writers have endeavored to create a special type to which these clinicians' names are attached, but happily without success.

2. A facio-scapulo-humeral type, to which attention was first specifically directed by Landouzy and Dejerine. The atrophy, as the name indicates, reveals itself first in the face, especially in the orbicular muscles of the eye and mouth, which gives a peculiar cherubic expression to the countenance, known as the myopathic face and tapir mouth. It then extends to the shoulder girdle and arm muscles, very rarely to the lower extremities. This variety of dystrophy is not associated with any manifestations of pseudo-hypertrophy. It occurs in early childhood and occasionally at any time up to the period of adolescence.

3. Juvenile form. This variety has been particularly studied by Erb, and first reveals itself about the time of puberty, and has a distribution very similar to the fascio-scapulo-humeral type, although the primary manifestation of atrophy is almost invariably in the shoulder girdle, while the face is involved later. Occasionally there is a slight degree of pseudo-hypertrophy accompanying the development of this form.

The accompanying table, taken from Sachs, shows the comparative similarity and differences of these three forms of the same disease:

TYPES OF PRIMARY DYSTROPHIES.

	Muscular pseudo-hypertrophy.	Juvenile form of progressive muscular atrophy. Erb's type.	Type Landouzy-Dejerine.
Part first affected.	Legs (calves)	Shoulder girdle	Face and shoulder girdle.
Distribution of hypertrophy.	Calves, rarely thighs..	Muscles around shoulder girdle and pelvic girdle.	None.
Distribution of atrophy.	Thighs, deep muscles of back, shoulders and scapular muscles. Calves during later period; at that time also general atrophy.	Thighs, deep muscles of back, upper arm. Hypertrophied parts may become atrophic in later stage.	Face muscles, including lips and orbicularis palpebrarum; shoulder and scapular muscles.
Parts remaining normal.	Face, forearm, and hand.	Face, forearm, hand and leg muscles, except in last stages.	Forearm, hand, and legs, and deep muscles of back.

Treatment of the Dystrophies.—The inefficiency of therapeutic measures to cope with muscular dystrophy is in a large measure explainable by the fact that we are dealing with an evolutionary defect in the muscles, and as there is very little borrowing from art to lend to nature very little can be accomplished in delaying the progress of the disease after it has once become manifest, nor is there any way of preventing the disease except by the voluntary renunciation of procreation by those whose ancestral and collateral family histories show this disease. It should be kept in mind that not all of those whose ancestry or family reveals the existence of dystrophy develop the disease. Many of them do not. It is in such individuals that great care should be had that no strain or excess be put upon the neuromuscular system, which might awaken to reality the dormant dystrophic tendency. As muscular dystrophy in all its clinical varieties is a disease of infancy and early youth, it need not be said that these precautionary measures are to be taken particularly during the early years. It goes without saying that individuals who are afflicted with the disease should not marry. Those whose immediate family history shows the existence of the disease should be warned of the danger of reappearance of muscular dystrophy in their descendants, even though they themselves remain entirely free from it. Such individuals should be urged to remain unmarried, and if they are married, to remain childless. As a matter of fact, the physician rarely has the opportunity of advising or applying prophylactic treatment except in those instances in which some member of the family who is already under treatment for this disease. In such a case the apparently healthy children should be carefully instructed in the development of their muscular systems by systematized exercises. The difficulty is to choose a happy medium between over-exercise which might arouse the latent tendency to the dis-

ease and insufficient exercise which might allow the muscles to fall into a state of inactivity atrophy. The general care of such an individual should be directed to maintaining a supreme degree of nutrition.

After the dystrophies have begun to develop something can always be done, and often a very great deal can be accomplished, in delaying the course of the disease, by the proper utilization of gymnastics, massage, electricity, proper dietary and hygiene, and the co-operation of the orthopædic surgeon. All writers are seemingly in accord that systematic exercise is the most important measure. A few cases have been reported in which it would seem that the progress of the disease had been brought to a standstill by the use of this measure alone. It is impossible to say, except in a general way, what form of gymnastic indulgence will be beneficial in a given case. It depends somewhat upon the clinical type of the disease, upon the stage of the disease, and upon the age of the patient. As a rule, it may be said that some form of resistance exercise, carefully graded, particular care being taken not to put too great resistance upon the atrophied muscles or groups of muscles, is the most beneficial. It has the advantage that it may be employed in very young children who cannot be taught ordinary gymnastics. Although the cases that have been reported in which systematic active and passive exercise was followed by considerable benefit are of the facio-scapulo-humeral type and the juvenile type, theoretically there is no reason why it would not be as available in the pseudo-hypertrophic group. In these latter cases, unfortunately, the apparent hypertrophy is often taken by the family and by the physician to indicate excessive muscular development, and the disease is not recognized until it has passed into the moderately advanced stage of lipomatosis and myosclerosis. Then usually much time is wasted in desultory application of electricity before systematic exercise is begun. The truth is that up to date the most important measure in delaying the progress of muscular dystrophy is systematic exercise, and the sooner it is begun the greater is the prospect of improvement. The hazard attending its use is that it may be overdone. The physician should be content with comparatively slight results even after the expenditure of prolonged treatment.

Electricity is of very slight service in the treatment of the dystrophies. This may be explained in part by the fact that it is rarely applied as methodically and persistently as should be done to make legitimate estimate of its capacity to delay the atrophy. In muscular dystrophy the electrical reaction is quantitatively diminished in keeping with the degree of degeneration of the muscular fibre. There is no true reaction of degeneration. This, of course, allows the galvanic or faradic current to be used so as to produce muscular contraction, and such muscular contraction, if brought about carefully and without much intensity, is theoretically of service to prevent at least inactivity atrophy, and it

may be of some use to delay the specific atrophy. The greatest care must be exercised not to overdo the application of electricity. A few contractions in the atrophied muscles produced once or twice daily are far more advisable than a prolonged *séance*. The coarsely interrupted faradic current is more advisable than the galvanic, especially in the early stages of the disease. The galvanic current has the advantage of stimulating the local circulation more than the faradic, and it may therefore be legitimately alternated with the former. The effects which electricity has to improve the local nutrition are much more definitely obtained by the use of massage, which should be applied in the shape of very light muscle kneading to every case of muscular dystrophy. In the utilization of these three measures, exercise, electricity, and massage, sight should not be lost of the fact that in the interval of their application the patient should be as nearly as possible at complete rest. Nothing can be more injurious than the attempts of patients to drag themselves about when the lower extremities are the seat of muscular dystrophy, or to use the upper extremities in some occupation when the disease is of the juvenile type. This should not be construed to mean that the patient should not be in the open air, and under auspices that contribute to general tonification of the muscular system. The aid of the orthopædic surgeon should be sought just as soon as deformities arising from contracture of unopposed muscles interfere with the getting about of the patient. Such contractures should be overcome by partial or complete tenotomy and the parts retained in an approximately normal condition by the use of the indicated prothetic apparatus. Occasionally, some such apparatus may be beneficial in giving support to the parts that are not deformed by the contracture.

During the past few years various animal extracts have been thoroughly tried in the treatment of dystrophy with the hope that benefit might accrue in some unknown way. Extract of the thymus gland has been extensively used and to lesser extent that of the thyroid also. In my own experience there is not the slightest semblance of evidence that they are of any benefit.

In brief, the treatment of the muscular dystrophies consists in the employment of those physical measures that are known to tonify the muscular system; in the adoption of dietary and hygienic means that serve to maintain general nutrition, and the adoption of measures that overcome deformity and contribute to the comfort of the patient. So far, no drug has been discovered that exercises any influence upon the course of the disease.

CHAPTER XVII.

THE TREATMENT OF MYOTONIA CONGENITA (THOMSEN'S DISEASE).

The name myotonia congenita is given to a peculiar family disease first described by Thomsen, a Silesian physician in whose family more than twenty cases occurred. It is characterized by the occurrence of chronic contraction in all the voluntary muscles on attempt at innervation or movement, while at rest the neuromuscular system appears to be quite normal save for the hypertrophy of the muscles which always exists after the disease has lasted for some time. The disease is classified as a family affection, but that it is not always familiary has been proven by a number of recent reports. The hereditary factor in its causation may be manifest as a direct transfer from an ascendant or indirectly by inherited disposition. The predisposition to its occurrence may be atavistic. Jacoby, among others, has shown that the symptom complex of the disease may occur independently of neuropathic heredity, developing after acute infectious diseases, such as typhoid fever and diphtheria, and transitorily after depraving influences, such as prolonged exposure to cold. He suggests that the names myotonia acquisita and myotonia transitoria be given respectively to these forms of the disease.

Myotonia congenita usually manifests itself in the early years of childhood, or at least before puberty, and frequently under the immediate auspices of fright, shock, or mental excitement. The essential feature of the disease is the occurrence of tonic spasm in the voluntary muscles on attempt at purposeful movements, and the inability of the patient to relax this tonic condition by force of the will. At the end of fifteen to thirty seconds the contraction relaxes spontaneously and after several repeated attempts at motion followed by a similar tonic spasm to a lesser degree, the patient is finally able to perform such purposeful movements, and for a long time, as walking, running, and dancing. The muscles present a characteristic mild tonic reaction constituted of normal mechanical, faradic, and galvanic irritability of the motor nerves, and increased irritability of the muscles. These, combined with absence of all symptoms pointing to a gross involvement of the nervous system, go to make up the essential feature of the disease. As in most neuropathic conditions, the occurrence of this disease is not infrequently associated with other symptoms pointing to an unstable nervous system, such as psychical symptoms, epilepsy, and migraine.

It is very doubtful that the disease can be looked upon as a congenital abnormality of the neuromuscular system, particularly in light of the fact that acquired and transitory forms occur. It would seem more legitimate to postulate an inherited or familiary instability of this system which can be called into active morbidity by factors arising from within and without the individual. Such an instability of the neuromuscular system may also be acquired. In the congenital form very little can be done to prevent this instability, but much may be done to delay the advent of its manifestations. The patient whose birthright entails the potentiality of this disease should be advised concerning the selection of an occupation or profession, and concerning the questions of marriage and propagation. He should be warned against those indulgences and habits that have a tendency to increase the irritability of the neuromuscular system. Such are strains, exposure to excessive cold and heat, excesses in eating and drinking, mental excitement, and the like. It should be made known to such patients that a quiet, uneventful life may be full of usefulness to themselves and others, and the existence of their disease need not necessarily shorten their allotted days. No treatment has so far been suggested that is of any service in overcoming the manifestations of the disease, save the adoption of measures looking toward this kind of an existence. Naturally, electricity, massage, gymnastics, and Swedish movements have all been thoroughly tried. They do not seem to have any particular beneficial effect. Some physicians have claimed that they have noted amelioration of the disease from the use of massage and graduated gymnastic exercises, but the consensus of opinion is that they are of very slight service. In the acquired form causal therapy should be employed in addition to the general measures already mentioned.

CHAPTER XVIII.

THE TREATMENT OF TETANUS.

Tetanus is an acute infectious disease manifesting its injuriousness principally on the neuromuscular system to cause tonic spasms, with exacerbations which show themselves first in the muscles of the jaw and later in all the voluntary muscles. It is due to the tetanus bacillus and to the toxin which it forms. The bacilli gain entrance to the system through a wound in the skin or mucous membrane, which is oftentimes so trivial that the patient has no knowledge of it, or has forgotten its occurrence. It is universally believed that the bacilli cannot penetrate through the unbroken integument, but there is much testimony going to show that the mucous membrane does not offer such complete resistance. It is, nevertheless, probable that when they secure entrance through a membrane, the latter has previously suffered some loss of its epithelial covering.

Etiology.—Tetanus is described as of four varieties from an etiological standpoint: (1) traumatic; (2) idiopathic; (3) neonatorum; (4) puerperal. As a matter of fact it is entirely probable that they are all due to one cause, the tetanus bacillus, and that in the idiopathic or rheumatic form the bacillus has gained entrance through some unknown abrasion of the tegumental surface. In the last two varieties the bacillus secures entrance through the funis and through the denuded inner surface of the uterus. The tetanus bacillus is present in countless numbers in the earth, particularly in certain localities. This accounts for the fact that the disease is more liable to occur in laborers, such as gardeners and farmers, and in those who get wounded by some implement lying on or in the ground, such as a nail, a scythe, or a splinter, and in those who having got a wound of any sort attempt to stanch the bleeding by the application of earth. Lowered vitality is undoubtedly an important predisposing cause. Thus it is more liable of occurrence in those who are surrounded by depraving influences. It occurs more often in the spring and early summer and during wet seasons than at other times. In this country the negro race seems especially predisposed, especially those living in the Southern States. In certain sections of the country, such as in Long Island, it seems to be endemic. In the larger cities the disease is rarely seen. This is probably accounted for by the fact that wounds are properly dressed in dispensaries and hospitals soon after their occur-

rence. Naturally the decrease in frequency of tetanus is due to the almost universal plan of treating wounds of any severity aseptically.

The bacilli of tetanus do not multiply and propagate within the body. Their locus is immediately surrounding the wound, and there they manufacture the toxins which on being absorbed into the system cause the phenomena of the disease. The knowledge of this fact has led many to advise that the seat of the wound and its immediate surroundings be completely extirpated in order successfully to prevent further intoxication.

Symptoms.—The period of incubation is not definitely known, but in the majority of instances it would seem to be about from two to ten days. In some instances it is much longer. The onset of the disease is usually marked by slight stiffness of the neck and face, which may become so complete before other manifestations of the disease occur that the jaws become firmly set and approximated, thus giving rise to the popular name "lock-jaw." Oftentimes the facial muscles of expression are more involved than the masticatory muscles, and when they are the result is a distressing distortion to which the name risus sardonicus is given. The extensor muscles of the back and extremities are next most liable to involvement, and the occurrence of the tetanic spasms here gives rise to opisthotonos and other painful positions of the body. The muscles of the arms and hands are least often affected. Not so the respiratory muscles, for in nearly all the fatal cases dissolution is immediately conditioned by the occurrence of tetanic spasm in them. Cutaneous irritability is enormously increased, and oftentimes the slightest breath of air or any cutaneous excitation that would not be detected in the normal person causes profound exacerbation of the tetanic spasms. These exacerbations are attended by extreme pain. The patient whose consciousness remains unaffected is in mortal dread of such irritation and lies with bated breath and with every evidence of anxiety lest some should come upon him. The bodily temperature rises from two to four degrees; the pulse in the beginning is tense and rapid, and later becomes feeble in keeping with the exhaustion or asphyxia that occurs if the disease is of great severity. The skin is bathed with perspiration, which becomes very profound during the accession of the spasms; and all the somatic functions are more or less disturbed.

The clinical picture that attends the occurrence of tetanus following wounds of the head, so-called head tetanus, or cephalic tetanus, differs considerably from the varieties just spoken of. The most conspicuous feature is a spasm of the gullet like that occurring in lyssa, which prevents the patient from swallowing. The next most striking peculiarity is the occurrence of facial paralysis, which is occasionally associated with paralysis of the eye muscles. The facial and ocular palsies are dependent upon an infectious neuritis of the respective nerves. The tetanus toxin manufactured around the wound in the head is carried

along the sheaths of the nerves by the endolymph, thus being given special facilities for causing a perineuritis. In this connection it may be said that the toxins of tetanus have a peculiar tendency to cause alterations of the motor neurons, not only in their peripheral distributions, but in the cell bodies of the ventral horns and the brain. Goldscheider and Flatau, Stintzing, Matthes, and others have demonstrated the occurrence of acute degeneration in the ganglion cells of the ventral horns in artificial and accidental tetanus. It is not unlikely that the toxins secure their accession to the cell bodies through the neural endolymph as well as through the blood.

Treatment.—The indications for treatment of tetanus may be summarized under two headings: First, the prophylactic, that is, to prevent the bacilli and the toxins that are the result of their existence and activity from getting into the system; and second, when this is impossible, which unfortunately is often the case, to prevent the further production of toxins and their absorption and to counteract the effects of toxins upon the central nervous system.

The general prophylaxis consists in educating those liable to the kind of wounds that are commonly infected by the tetanus bacillus that the only reliable safeguard against the development of tetanus is to have the wound, trifling though it may appear, thoroughly and aseptically cleaned and dressed. The fact that the bacilli propagate only in the wound and in its very immediate environment has led many to advocate the complete excision of these parts. Undoubtedly such a radical and drastic procedure would be successful in many instances if patients would submit to it, but the majority of them will not. The wound which gave the bacilli an avenue of entrance may have long since healed, and it is difficult for the patient under such circumstances fully to comprehend how extirpation of the part would lead to a cure. If the patient is seen while the wound is still present, it should be excised or thoroughly curetted and treated antiseptically. For this purpose the ordinary antiseptic solutions, such as carbolic acid and bichloride of mercury, are of little use. The best antiseptic is a solution of iodine, which should be applied freely.

There is no drug that has any influence to kill the bacillus or to neutralize the toxins, and the plan of treatment that has been relied upon until lately consists in the administration of antispasmodics and the adoption of measures to maintain the patient's strength. If life can be prolonged and such accidents as suffocation and inanition prevented, the system will be able to rid itself of the noxious agencies through the normal avenues of elimination. These should be stimulated to a moderate degree, especially the skin and the intestinal tract, but not to such an extent as to weaken the patient. The skin is usually functionally active in this disease, but its activity may be enhanced by giving an abundance of water, by diaphoretics that do not prostrate, and by ex-

ternal warmth if the patient has no fever. To lessen the intensity of the spasms in the voluntary muscles a number of medicines may be given, the most important being the bromides, chloral, and morphine internally, and the inhalation of chloroform and chloride of ethyl. It is necessary oftentimes to give the former in large doses, especially the bromides and chloral. Cases have been recorded in which a half-ounce of the former and ninety grains of the latter have been given with good results. Morphine serves a double purpose in tetanus: it blunts sensorial perceptivity, and acts powerfully to prevent motorial response. These drugs should be given through a feeding tube or by the rectum, in cases in which there is dysphagia from spasm of the gullet. Indeed, in some cases it is necessary to administer nutriment in this way on account of this condition and of the lockjaw. The cutaneous hypersensitiveness is often effectually counteracted by keeping the patient immersed in warm water for hours at a time, and then by applying the wet pack. The greatest care should be taken to spare the patient all forms of sensorial irritation. In the so-called rheumatic variety salicylates have naturally been recommended and given. But it is well to bear in mind that the belief that such cases are dependent upon the tetanus bacillus is becoming accepted. In the light of this, so-called rheumatic tetanus calls for the same kind of treatment as any other clinical variety.

In many cases the plan of treatment outlined has been and is still successful. But during the past ten years evidence of a convincing kind has been gradually accumulating to show that there is a specific treatment for tetanus, which consists in the administration of the serum of immunized animals, the tetanus antitoxin. There are many preparations of antitoxin to be had, and so far as can be judged from the published reports of their use one is as efficacious as another. The commoner varieties that are used in Europe are those of Tizzoni, Hoechst, Bern, and Behring. These are to be had in this country, but they have no advantages over that supplied by the New York City Board of Health. Entire reliance should not be placed upon this measure any more than upon the administration of diphtheria antitoxin as encompassing the duty of a physician in treating a case of diphtheria. On the contrary, when the tetanus antitoxin is administered the wound should be thoroughly curetted and cleansed, excised if the patient will consent to it and if a very long time has elapsed since the infliction of the wound, and the general treatment already spoken of carried out. In the first few years following the recommendation of serum therapy in tetanus, the results of its trial did not seem to be very encouraging, but during the past two or three years a sufficient number of cases have been reported to demonstrate its superiority to every other form of treatment. For instance, Engelmann has recently published a review of thirty-six cases treated according to Tizzoni's plan, in which there were only eight deaths, and eighteen cases

with Behring's serum with seven deaths. Many unfavorable results have been recorded, but it is probable that in some of these the antitoxin was not used in sufficiently large doses. From gr. xl.–lxxx. of the dry antitoxin dissolved in ten times the quantity of water may be considered an average dose. The principles underlying its application are exactly the same as those for giving diphtheria antitoxin in diphtheria, and although the results so far have not been so brilliant as those which have attended the use of diphtherial antitoxin, they are, nevertheless, sufficient to warrant its unqualified recommendation. In order to neutralize the poison of the tetanus toxin the size of the dose must be increased with each hour that the treatment is delayed. For this reason it is very important that the antitoxin be administered as early as possible. When, however, the infection is of considerable intensity, as evinced by the rapid development of symptoms, short incubation period, from five to eight days, or conspicuous bulbar phenomena; or when the treatment is delayed until several days after the appearance of the symptoms, at least 100 c.c. should be used during the first twenty-four hours of treatment, the contents of one phial being given at the first injection, and this dose repeated at short intervals. When the wound has not been treated, even though the symptoms are slight, the toxin is administered in large doses. The best method of administration has not as yet been fully determined, but at the present time the method of intra-cerebral injection as suggested by Roux and Bourrel has not shown itself superior to deep hypodermic injection into the subcutaneous cellular tissue (see page 50). The tetanus antitoxin may be obtained in this country from the New York Board of Health and probably from the laboratories of other municipal health boards. The Italian and German antitoxins are also imported by Merck. In addition to the general measures already spoken of, it is often necessary to administer some sleep-producing agency in addition to chloral. The best of these is paraldehyde. It is of the greatest importance to anticipate and avoid complications, especially inanition and asphyxia. The former must be combated by the use of highly nutritious and concentrated nourishment, and the latter by the use of the rapidly acting antispasmodics. Nurses should be in constant attendance ready to employ artificial respiration on the slightest evidence of asphyxiation. Tracheotomy is useless, for the spasms will occur in the muscles of respiration just as surely when there is an opening in the trachea. If the patient can be tided over the first week, the chances of recovery are excellent.

CHAPTER XIX.

THE TREATMENT OF TETANY.

TETANY is a peculiar motor neurosis of toxic or infectious origin, characterized by intermittent recurring tonic spasm in the muscles of the hand and sometimes in other parts of the body, such as the foot, very rarely in muscles of the trunk; by increased mechanical irritability of the motor nerves, Chvostek's symptom; by increased electrical irritability of the motor nerve, Erb's symptom; by increased mechanical and electrical irritability of the sensory nerve, constituting the condition known as Hoffman's symptom; and by the occurrence of a cramp condition when deep pressure is made on the muscles of an extremity wherein the tonic spasm has been manifest, known as Trousseau's symptom. As a rule, there is no disturbance of consciousness, although in many instances the patient is emotional and of a more or less hysterical disposition.

Tetany is more common before the fifth year than at any other period. Males are affected oftener than females. Overwork, insufficient and unsuitable food, and bad hygiene are important predisposing causes. It is not dependent upon any individual infection or intoxication, that is, it is not associated with any special organism or poison. It sometimes occurs with chronic catarrh of the stomach and intestines, and in such instances it is probably due to the action of peptotoxins and intestinal toxins. Occasionally it follows one of the acute infectious diseases, such as typhoid fever, dysentery, and cholera. It sometimes follows the injection of one of the vegetable and mineral poisons, such as ergot, alcohol, chloroform, lead, phosphorus, and tobacco. It occurs occasionally after partial or complete ablation of the thyroid gland undertaken for the cure of goitre, and in such instances it is due to the presence of toxins in the system that are normally counteracted by the secretion of this gland, or that develop on account of the absence of such secretion. It occurs with conditions of bodily depravity, such as are induced by pregnancy and lactation, and with the disturbance of nutrition at the basis of rhachitis. In some cases no cause whatever can be found. In all probability the phenomena of the disease are conditioned by the activity of the attributed poison on the central nervous system, usually the brain.

Constitutional Treatment.—The treatment of tetany may be summarized in a line: discover the cause, then render it non-operative, and, if possible, remove it. The discovery of the cause is usually much easier than

its removal. For instance, cases of tetany occurring with dilatation of the stomach may be treated symptomatically with considerable relief, but the chronic ulceration near the pylorus, which frequently attends this condition, will require assiduous and long-continued treatment. Even then, from one-half to two-thirds of these patients succumb, while in the ordinary forms of tetany almost every case recovers, even though no treatment be instituted. After the causes of the disease are combated and removed, measures should be taken to prevent further impoverishment of the blood and to restore it as soon as possible to a normal condition. The treatment directed to maintenance of the general bodily tone should be ardently carried out. Excessive work and enervating indulgences should be foresworn and the patient urged to get complete rest if possible. When the symptom complex follows an infectious disease, the administration of salicylic acid in ten- to fifteen-grain doses, taken with large quantities of water, seems to have a decidedly beneficial effect. If the patient is not already weakened from previous infection or intoxication, diaphoretics are sometimes advantageously given. There is no specific medication. The liability to the occurrence of tetany should always be borne in mind when operations on the thyroid are advised, and whenever possible the surgeon should be counselled to do a resection rather than an extirpation. When the symptom occurs after operation on the thyroid, transplantation of the thyroid and thyroid administration, either in shape of the fresh thyroid gland or tablets of the desiccated extract, should be employed. When the disease occurs in pregnancy and lactation, measures taken to combat the hydræmia may be sufficient to cope with it. No hesitation should be had in advising weaning at once, it matters not how young the infant is. Occasionally the symptoms become so severe in pregnancy that the question of emptying the uterus must be considered. All means for the control of the tetanic spasm should be exhausted before this is undertaken.

When the disease occurs in children and apparently without cause, it is well to bear in mind that the symptom complex sometimes follows the hydræmia produced by intestinal worms, and that a few sharp doses of an anthelmintic will start these patients toward recovery.

In very rare instances the tetanic spasm extends from the muscles of the hand and forearm to the trunk and extremities, and causes symptoms of asphyxia which may lead rapidly to death. If such a condition occurs, there should be no hesitation in employing inhalations of chloroform if the patient can be induced to make inspiratory effort. If he cannot, morphine should be given hypodermatically and a clyster containing a full dose of bromide and belladonna administered later. In a case reported by Koster general tetanic spasm was found after death to be dependent upon widespread arterial sclerosis and small hemorrhages on the anterior surface of the cauda equina and around the roots of the third, fourth, and fifth cervical nerves.

The convalescence of patients who have had tetany is often tedious and calls for the most assiduous dietetic and hygienic supervision.

Treatment of the Spasm.—An effort should be made to allay pain and to overcome the muscular contraction. The medicines that have been found most useful for these purposes are a combination of chloral and belladonna, or chloral and bromide. In severer cases, hyoscyamine in one-one-hundredth-grain doses for an adult, and curarine, the dose depending upon the preparation employed, may be given hypodermatically. As a rule, the first-mentioned measures, if associated with prolonged lukewarm baths for their sedative effect upon the peripheral sensory nerves, combined with revulsive and stimulating applications over the spine and light massage of the extremities, will be quite sufficient.

The use of quinine, opiates, valerian, and cocaine should be avoided, except to meet special indications. Even then they should be employed merely as symptom medicines. A word must be said concerning the use of the bromides. Although they are often of signal service in alleviating the spasm, they should not be given for a prolonged time, as they exercise a deleterious action upon the blood which is already in a bad way.

The galvanic current can often be employed with great efficaciousness. The best method of applying it would seem to be to place the cathode attached to large electrode on the back of the neck or on the chest, and the anode, in connection with a smaller electrode, over the nerve trunk supplying the parts which are the seat of spasm, and allowing the current of three to six milliamperes to flow uninterruptedly for from five to ten minutes. This procedure should be repeated twice a day. The faradic current should never be used, for its effect would be to aggravate all the symptoms.

Tetany occurring in infants seems to be a much more serious disease than tetany of adults. Happily it is of rare occurrence. In the former it not infrequently leads to death, while in the latter, unless it be associated with ulceration or dilatation of the stomach, almost invariably recovers. In infantile tetany the digestive tract should be carefully examined, and undigested substances in the stomach removed by the administration of a mild emetic, such as a considerable quantity of lukewarm water. The patient should then be given a brisk cathartic or the intestines thoroughly irrigated. After that, reliance must be placed upon the customary measures for the treatment of this condition in the adult, and in the efficaciousness of means taken to counteract the rhachitis with which it is almost always associated.

CHAPTER XX

THE TREATMENT OF MULTIPLE NEURITIS.

THE simultaneous participation of many nerves, neither functionally nor anatomically associated, in an inflammatory process involving the sheath or the axial core, is known as multiple neuritis. The clinical picture that it produces is oftentimes that of disease of the central nervous system. It is a disease whose recognition and causation have been fully interpreted only in modern times. The etiology of multiple neuritis, if written in detail, would require a chapter to itself. The principal facts may be summarized as follows:

Predisposing Causes.—By far the most important is a neuropathic predisposition which may be inherited or acquired. The rôle played by predisposition may best be illustrated by examples. Two apparently normally developed and healthy persons consume the same excessive quantity of alcoholic liquor for a year. At the end of that time one has multiple neuritis; the other is apparently unharmed. Again, out of a number of healthy workmen, exposed to the fumes of bisulphide of carbon, one or two only may develop polyneuritis. Almost innumerable examples having the same bearing and open to similar interpretation might be cited. It is difficult to state in so many words the nature of the predisposition which makes them vulnerable. The remarks on the vulnerability and resistance of nervous tissue to injurious substances should be read in this connection (see page 4). It must suffice here to say that if the ancestral and personal history of the patient is inquired into, either inherited or acquired deviations from the normal will frequently be found. Other predisposing causes may be summarized in a line. Anything that depresses general vital resistance, and especially anything that at the same time causes local depression, may be a predisposing factor.

Exciting Causes.—The actual causes of polyneuritis may be summarized under two headings:

1. *Intoxications*, which may be subdivided into: (*a*) Endogenous poisons that arise from within the system, and that are originally destined for elimination, may by their retention and absorption into the system produce intoxication, whose perniciousness is operative particularly on the peripheral nerves (polyneuritis which occasionally occurs in pregnancy may be of this sort), or the intoxication may arise from substances

that are the result of a disease process going on in the system, which produces in turn agencies that are destructive to certain tissues. Under this latter caption are included the polyneuritides of diabetes, of gout, of acute articular rheumatism, and possibly also those accompanying cancer and other forms of cachexia. Occasionally a case of multiple neuritis is met with in which there is no attributable cause save the precedence of gastro-intestinal manifestations. These cases are thought to be due to autointoxication from the alimentary tract. The early concurrence of mental symptoms gives color to this view. (*b*) Exogenous poisons, therefore intoxication coming from without and exercising a destructive action upon neuraxons, and to a lesser extent on the entire neuron. These poisonous agencies, enumerated in the order of their importance as causative factors of multiple neuritis, are: alcohol, arsenic, lead, copper, mercury, silver, sulphide of carbon, oxide of carbon, turpentine, aniline, and nicotine. Of these by far the most malign is alcohol. It is not unlikely that it causes more multiple neuritis than all the other intoxicants. Alcoholic multiple neuritis is liable to occur at any age, although naturally it is seen most frequently in adults. I have now under observation a seven-year-old boy who is suffering from a second attack of alcoholic multiple neuritis, due to the beer habit. The first attack occurred when he was four years old. Multiple neuritis occurs as frequently in women as in men. My own statistics show it to be more common in women. It seems especially likely to attack those who drink secretly. I have seen a number of instances of its occurrence in women and clergymen who began taking stimulants to brace them up, and who fell into a custom which the Scotchman calls "canny," that is, taking it with milk, the milk being put in the glass first. The quantity of whiskey taken can then be estimated only by results, and as these are usually pleasurable, this plan appeals to them. The condition of the general health has much to do in determining the onset of alcoholic multiple neuritis. Those who are vigorous and whose eliminative organs and channels are in active condition are practically immune to this manifestation of alcoholic poisoning, especially if they inherit a stable nervous organization.

Arsenical polyneuritis occurs most frequently as the result of taking arsenic with suicidal intent, and for therapeutic effect, as in chorea and progressive pernicious anæmia. Occasionally the source of the poisoning is from cosmetics and decoration. More than one factor is operative in causing the multiple neuritis which sometimes follows the taking of arsenic for suicidal purpose. In addition to the colossal depression which exists, there is the shock to the general nervous system incident to the non-completion of the act, and oftentimes the crime is perpetrated toward the end of a drinking bout. The different intoxicants which cause multiple neuritis have more or less of an elective effect. Alcohol, for instance, is especially liable to affect the extensors of the lower extremities,

especially at first. Arsenic, on the other hand, has a special predilection for the flexor muscles, both of the lower and of the upper extremities, while lead singles out in a most remarkable way the extensor muscles, particularly those innervated by the musculo-spiral nerves.

2. *Infections.*—The causes included under this heading are very numerous, and only the more important ones will be mentioned. Neuritis due to infection may be subdivided into: (*a*) The endemic form, known in the Orient, to which region it is confined except when exported, as beri-beri, or kakke, probably due to a pathogenic organism; and (*b*) those forms occurring after simple infectious fever, and due to the pernicious effect of toxins which have been engendered during the process of auto-immunization. This form of multiple neuritis is especially liable to follow diphtheria, typhoid fever, sepsis and its various localized forms, such as puerperal fever and septic endocarditis, tuberculosis, dysentery, leprosy, malaria, erysipelas, diplococcus pneumonia, influenza, simple angina, and gonorrhœa. Some writers have contended that occasionally multiple neuritis is due to syphilis, but the experience of American neurologists is opposed to this view. A slowly progressive form of polyneuritis occurring in the aged is dependent upon senile changes in the blood-vessels.

Symptoms.—The disease may develop in an acute, subacute, or chronic fashion. The latter way is the rule when the polyneuritis is dependent upon and associated with cachexia, such as cancer. The mode of onset varies also according to the causation. If alcohol is the attributable agency, mental symptoms such as depression, emotionalism, mental unrest on the one hand, and unaccountable fatigue, amyosthenia, cramp of the muscles of the legs on the other, are the customary forerunners. When the disease comes on abruptly, it will be accompanied by the ordinary febrile manifestations: elevation of temperature, which may reach 103° F., general feeling of illness and prostration, loss of appetite, diminished quantity of urine, and occasionally a slight amount of albuminuria. With or without these introductory symptoms the disease presents itself under three clinical forms: (1) motor form; (2) sensory form; (3) an ataxic form. Although motor, sensory, and ataxic manifestations are present in nearly every case, usually one of these predominates.

The motor form is by far the most common. It is called motor form, not that sensory symptoms are absent, but because the motor manifestations are so conspicuous. The motor symptoms are paresis of voluntary muscles, which may be of such a degree as to result in extreme flaccid paralysis; difficulty of co-ordination, which manifests itself on using the extremities, and perhaps also in speech; and very rarely partial loss of function of involuntary muscles, such as those of the bladder and rectum. The lower extremities are oftenest the seat of the lesion and the peroneal group of muscles is most likely to be paralyzed. With the paralysis there are

associated pain of varying severity and character along the course of the nerve; painfulness of the nerve trunks and branches on deep-seated pressure; loss of electrical irritability in the nerves and in the muscles, which may be so great as to constitute complete reaction of degeneration, loss of response to the faradic current and altered polar irritability to the galvanic; rapidly progressing atrophy of the muscles; impairment of the deep reflexes, such as the knee jerk, which will be completely absent when the nerves supplying the muscles entering into the formation of the quadriceps extensor are inflamed; and some degree of trophic changes, especially that known as glossy skin. If the neuritis is due to poisoning by alcohol, mental symptoms varying from pathological emotionalism through various degrees of mania and dementia may be present. The secondary symptoms or late symptomatic phenomena of the motor form of multiple neuritis are those of deformity in the extremities, due to secondary contracture in the inflamed neuromuscular tissues and to the unopposed contraction of the healthy muscles, and a peculiar mental state, characterized particularly by a conviction amounting almost to an obsession of motor impotency and a general hysteroid condition.

The sensory form is characterized particularly by pain of varying degrees of intensity, referred to the course and distribution of the affected nerves, and of a more or less continuous nature, though liable to brief or continuous periods of exacerbation. The pain is described as stabbing, burning, tearing, and shooting. It is increased by active or passive motion, and oftentimes by the pressure of the bed clothing. The affected extremities in this variety are in the beginning extremely hyperæsthetic, but as time goes on areas of anæsthesia, irregularly distributed over the extremity, can be made out. The hyperæsthesia, however, continues in other areas throughout the entire course of the disease. Voluntary movement is more or less affected, and the reflexes are usually exaggerated, especially in the beginning.

The ataxic form, often called neuro-tabes or pseudo-tabes, because the more obvious symptoms parallelize those of true tabes or locomotor ataxia, usually develops insidiously, or in a subacute fashion. The principal phenomenon is ataxia, of either the upper or lower extremities, according to the part involved, associated with subjective sensations of numbness, formication, and pain, and with more or less loss of muscular sense. Cutaneous sensibility is usually preserved, while the reflexes, both superficial and deep, are diminished and sometimes lost. The nerve trunks and muscles are sensitive to deep-seated pressure, and there may be partial reaction of degeneration in both the muscles and the nerves.

These three clinical types of multiple neuritis have many symptoms in common, which, however, are not necessarily present in any given case. These are local or general œdema of an extremity, especially lia-

ble to be manifest over an articulation; tachycardia and cardiac palpitation, evidences of implication of the vagus nerve by the injurious agency; shining, glossy skin; sluggishness of the pupils, sometimes optic neuritis, and hemorrhages into the retina; and the formation of bedsores.

The course of the disease is a progressive one for a few weeks in the acute variety, and for a few months in the subacute variety. The course of the chronic variety depends entirely upon the cachexia with which it is associated. The prognosis in all forms of multiple neuritis in which the cause is discoverable, removable, or its activity self-limiting, is favorable except in those cases in which the respiratory muscles are involved and in those showing early or profound implication of the pneumogastric nerve. Despite this, however, more patients die from multiple neuritis than from almost any other disease of comparable severity. This is due to the fact that their infirmity and its entailment render them particularly liable to tuberculous infection, while in other cases that apparently recover recurrence of the inflammation is due to inability of the patient to avoid the injurious substance, be it taken into the system for pleasure or in the winning of a livelihood, which first caused the disease.

Treatment.—The treatment of multiple neuritis will be referred to under three headings: (1) prophylactic treatment; (2) treatment of the cause; (3) the remedial treatment, which will include a discussion of measures necessary to bring about anatomical and physiological restitution.

Prophylaxis.—Considering what has been said of the importance of inherited or acquired neuropathic diathesis in the genesis of multiple neuritis, it is not at all surprising that the prophylactic treatment may be of great usefulness. To summarize briefly what might be said under this caption: Persons exposed to the activity of intoxications or infections known to be capable of causing multiple neuritis, whether these be incurred purposely, as in taking alcohol; accidentally, as after the infectious disease; or of necessity, such as exposure to the metallic poisons, should be apprised of the dangers and advised not only to avoid these injurious agencies but to indulge in measures which are known to be contributory to the production and maintenance of a high degree of vitality and health. As a matter of fact, the physician does not often have the opportunity given to him of meting out such instructions, except when the patient consults him for some symptom, the presence of which indicates the beginning of disease of the peripheral nerves, or the presence in the system of a substance that may cause such disease. It is unnecessary here to enumerate the various means to be utilized in overcoming the shortcomings of an acquired or inherited predisposition. No more is it necessary to enumerate the various hygienic, dietetic, eliminative procedures utilizable for counteracting the pernicious effects of substances capable of inciting multiple neuritis, as attention has been given to this in Part I. The general practi-

tioner should bear in mind the liability to occurrence of multiple neuritis after the infectious diseases, and so conduct the period of convalescence that no exhaustion shall be put prematurely upon the neuromuscular mechanism. I am convinced that many cases of diphtheritic and influenzal multiple neuritis would not occur if the period of convalescence was more carefully guarded. It is not sufficient to prevent the patient from exhausting his strength and depressing his vitality at this time, the weakened and depraved system should be fortified by reconstructive alimentation, by the proper use of fresh air, sunlight, and sleep, nature's remedies; and by friction, massage, hydrotherapy, and gymnastics. It is particularly to individuals who do not have a clear bill of health from inheritancy that such care should be given.

Causal Treatment.—The causal treatment of multiple neuritis is theoretically a very simple matter. Practically, it is oftentimes very difficult to put in application. In the first place, the cause cannot always be discovered. In many cases of alcoholic multiple neuritis, especially in women, the drink habit is obstinately denied, often with a semblance of righteous indignation. Oftentimes in such cases the ingestion of alcohol is kept up, even though the patient be cognizant of its deleteriousness. On the other hand, the metallic poisons may arise from most unexpected sources and their presence in the system be for a long time undetectable. In some cases the previous occurrence of influenza or other form of mild infectious disease has either been forgotten or it is thought of too little importance to be mentioned to the physician. Thus it is evident that before causal treatment can be applied it is oftentimes necessary to make a prolonged and diligent search of the etiology. Even then it is not always possible to convince one's self of the rôle played by certain detectable conditions, more than one of which may be thought is sufficient to cause the disease. This is particularly true of the autointoxications. Chemistry has not as yet devised means whereby it can be said positively from examinations of the excreta or the secreta that autointoxicants sufficient to cause inflammation are being manufactured within the body. We may be led to the suspicion of their existence by the occurrence of symptoms generally believed to be dependent upon such conditions, and on account of these it may be legitimate to infer that the inflammation of the nerves should be reckoned among the consequences. In certain autointoxications, such as diabetes, the relation between cause and effect is obvious, and the indications for treatment are very evident. It has already been stated that syphilis probably never causes multiple neuritis. Mindful, however, of the fact that a few writers have reported cases of such occurrence, it may be said that if one were able to convince himself of a causal relationship between syphilis and multiple neuritis, it would be a signal for the vigorous use of antisyphilitic remedies.

Remedial Treatment.—The remedial treatment of multiple neuritis

should be undertaken early. The most important part of it is rest. It matters not how slight the neuritis may be, both the rapidity and the completeness of recovery will be enhanced by rest. Whenever possible, the patient should be confined to bed and not allowed to perform any voluntary movement; although able to stand or walk, he should not be allowed to get out of bed even to respond to the calls of nature, no more should he be allowed to feed himself or to use the hands for any purpose. The immediate treatment should be concerned in relieving pain, combating insomnia, alleviating bladder symptoms, and watching for and anticipating cardiac and respiratory implication. Occasionally it will be necessary to direct treatment immediately to delirium or other mental accompaniments of multiple neuritis, but usually the indications mentioned encompass the systematic treatment. After the inflammatory process has reached its height and the regenerative stage sets in, the indications for treatment are: (1) to combat the muscular atrophy, (2) to prevent the occurrence of deformity, (3) to rehabilitate the loss of muscular sense and consequent disorder of function, and finally (4) to assist in the regeneration of self-confidence and mental equilibrium the lack of which are such striking features in many cases.

The most immediate and pointed indication is for the relief of pain. Oftentimes the pain is of such severity and continuousness that it exhausts the patient. If for no other reason, this alone would urge the need of analgesics. Morphine in some form is naturally the surest member of this class, and in the beginning of the disease it should be administered preferably by the alimentary tract, but only when the patient is under the complete control of the physician and the espionage of a nurse or hospital. Otherwise relief from the pain might be followed by the indulgence in alcohol, which would in turn necessitate a repetition of the morphine, and thus a drug habit might be easily acquired. In the majority of cases absolute rest, combined with external applications of dry heat or cold, depending upon the thermal element that is most grateful to the patient, is sufficient to make him moderately comfortable, and especially if the modern analgesics, such as phenacetin, antipyrin, salicylate of sodium, salophen, and like substances be given. It is necessary to bear in mind, however, that all of these synthetic products have a tendency to depress the vegetative system, particularly that part of it represented by the pneumogastric nerve. Their administration, therefore, should be coupled with the utilization of fortifying measures and remedies. Of these dry heat applied to the extremities and over the abdomen is of great service. Forms of multiple neuritis that seem to have occurred as the result of refrigeration or from such hæmic dissociations as those forming the basis of rheumatism are favorably influenced by the administration of the salicylates, which it is well known are analgesic agents of considerable power. I have had encouraging results from

the administration of methylene blue, as suggested by Ehrlich and Litmann, when administered in pill form. Considering the elective affinity which this substance has for nerve trunks when applied post mortem, it is legitimate to infer that its administration causes some changes that make for restitution in the diseased nerve. On the other hand, I have had no experience with the subcutaneous administration of carbolic acid given in a two-per-cent solution directly into the area of the inflamed nerves, as recommended by Eulenburg. Nor am I able to formulate any satisfactory hypothesis to explain the working of such medication.

One of the most troublesome accompaniments of the early stages of multiple neuritis is insomnia. It is especially liable to occur in the alcoholic form. Measures must be taken early to combat its existence, fo little reparative process can go on in the system during its occurrenc There is nothing in the character or occurrence of the insomnia to call f different medication than that utilizable in insomnia of the acute and e hausting diseases, save that chloral should be avoided. It not only ha a tendency to lower blood pressure by an elective effect upon the pneumogastric nerve, but it is a powerful hæmatolytic agency. Although the bromine salts are not true hypnotics, nevertheless they are often conducive to the occurrence of sleep by soothing peripheral irritation, and their administration in multiple neuritis, especially if exhibited with morphine to relieve pain, gives gratifying results. The administration of sulfonal and trional in twenty-grain doses usually suffices to bring about a degree of sleep, especially if given in connection with some diffusible stimulant, such as carbonate of ammonia and administered in hot milk. Paraldehyde is likewise a drug that may oftentimes be given with great effectiveness for the relief of this symptom. Its dose is from half a drachm to a drachm, but double this quantity may be given without deleterious results. Were it not for its disagreeable flavor and taste and all-pervading, enduring odor, it would deserve to be used more extensively. Insomnia may likewise be combated by the prolonged warm bath, or by the application of the dripping sheet, both of which have a soothing and beneficial effect upon the peripheral nerves.

Other symptoms that may occur calling for therapy directed immediately against the existence of the condition which their presence signifies are paralysis of one or more of the cranial nerves, such as the pneumogastric, extension of paralysis to the respiratory organs, and acute trophic manifestations. Very rarely are vesical shortcomings of sufficient intensity or gravity to call for direct interference. When they are, they easily yield to regular catheterization. The involvement of a single cranial nerve has no other significance therapeutically than to direct attention to the possibility that other, and perhaps more vital, nerves of this group may become involved. When tachycardia is associated with feebleness of cardiac and arterial impulse, irregular rhythm of the pulse,

threatened syncope, cold extremities, etc., and such subjective manifestations as profound mental unrest and fear, diffusible stimulants and cardiac excitants that are known to act on the musculature of the heart walls should be given at once. For this purpose carbonate of ammonia may be used in two-grain doses every hour if necessary, while camphor and caffeine, administered internally, are alternated with the use of strophanthus or strychnine, administered subcutaneously. Much can be done in averting what may seem to be an impending catastrophe by the use of these measures, particularly if the patient is kept in a state of most profound rest, and by the application of warmth to the extremities and a cold compress to the cardiac region. Faradization of the pneumogastric has often been recommended to avert the disagreeable symptoms pointing to implication of the pneumogastric in cases of diphtheritic palsy, and at times it has seemed to me to be an agency worthy of considerable confidence. It is difficult, however, to estimate just how much good it does. There can be no doubt that its intemperate application may be an agency for harm. Therefore, it should be given in short *séances*, repeated three or four times daily, and if no beneficial effects are manifest after a few days its use entirely stopped.

Failure of the respiratory power is to be treated in quite the same way as when it arises from any other condition. That is, an endeavor should be made by flagellating the skin or by the application of a strong faradic current, to incite the inspiratory centre in the oblongata to more powerful and renewed effort; while some beneficial effects may be obtained from the inhalation of oxygen. Although physiology teaches that the amount of oxygen breathed stands in no relationship to the quantity which the blood will take up, nevertheless the patient often gets relief from the use of such inhalations. The respiratory movements may also be aided by any of the mechanical means which are used for the facilitation of expansion and contraction of the chest. Injections of strychnine should likewise be given up to the point of slight manifestations of its physiological effect. It is frequently necessary when there is paralysis of the fauces, such as often attends diphtheritic multiple neuritis, that the greatest care be exercised that particles of food do not find their way into the respiratory passages, thus leading to a form of pneumonia which is almost invariably fatal. A tendency to such occurrence is heralded by prolonged, spasmodic attacks of coughing which the patient has after swallowing liquid or solid food, especially the former. Although it is advisable to delay the resort to the feeding-tube as long as possible, no hesitation should be had in using it when the indications are sufficient to demand it. It is well to bear in mind that its introduction under such circumstances is rather different from that under normal conditions. Ordinarily the glottis very promptly closes the entrance to the respiratory tract when the guiding finger of the surgeon's hand is passed into the

pharyngeal region to direct the entering tube, but in diphtheria these parts are paralyzed and the tube may readily enter the larynx. Not that the tube will be passed into the respiratory tract, but the efforts of guiding it into the gullet may be provocative of exhausting attacks of coughing which may lead to profound and fatal syncope.

General Restorative Treatment.—After having thus passed in review the symptomatic treatment of multiple neuritis, the general restorative treatment remains to be considered. The measures that are useful for this purpose do not differ materially from those enumerated and discussed in the chapter on acute poliomyelitis. The objects are to delay and prevent trophic changes, to facilitate restitution of the diseased nerves, and to prevent deformity. An important question to decide in every instance is, When should such treatment be begun? It is impossible to answer this question in a way that will be applicable to every case. It depends very largely upon the nature and intensity of the inflammation, and to a lesser extent upon the patient's morale and resistance. As a general rule, however, it may be said that as soon as the affected extremity or parts may be handled carefully without causing the patient considerable pain, the application of electricity should be begun. As in the flaccid paralysis resulting from anterior poliomyelitis, the galvanic current, applied in the labile fashion, should be utilized at first; while after the inflammation has further subsided, attempts should be made to get contraction of the muscle directly or indirectly through the nerve by means of whichever current, faradic or galvanic, to which the parts are most responsive. The electrical treatment should be given in short *séances*, twice a day if possible, and kept up for a long time, or until the parts are so restored to health that the patient can give them the necessary exercise by voluntary movements. The mistake is frequently made of causing an atrophied muscle to contract too often by the use of the current to which it is responsive. Three or four contractions, produced twice daily, are far more serviceable for this purpose than several times that number, given with the idea of forcing the recovery. Light friction to the skin and very gentle massage may be instituted coincidently with the electrical treatment for the purposes of improving the circulation and the nutrition of the paralyzed parts. As the inflammation in the nerves subsides, the severity of the massage may be beneficially increased. It is a powerful agency for good in the prevention of deforming contractures. It is by no means necessary to have a professional operator for its application, for its beneficial effects are dependent entirely upon simple rubbing and manipulation, which may as well be done by a nurse or by one of the family who gives the time to it.

The most important medicine to facilitate the restitution of the paralyzed parts is unquestionably strychnine. Its administration, preferably

subcutaneously, should be begun as soon as the acuteness of the inflammatory process has subsided, and kept up for several months, with occasional intermissions, during which time other tonic administration may be substituted. It is advisable to begin with a dose of from one-one-hundredth to one-sixtieth, and the quantity is gradually increased until the patient is taking from one-twelfth to one-sixth of a grain in twenty-four hours. The latter quantity can often be given without any perceptible toxic effects. The causative agencies of alcoholic multiple neuritis act perniciously upon the blood and upon the blood-elaborating organs, and it is therefore expedient to look to the restoration of these tissues. Different cases call for different treatment in this respect, but as a rule it may be said that small doses of iodide of potassium, the dilute mineral acids if there are no pointed contraindications to their use, and some absorbable preparation of iron, are always in order. If refrigeration, the rheumatic diathesis, or autointoxication seems to play a part in the etiology, the salts of salicylic acid, such as those of sodium and potassium, should be administered.

In another connection, attention has been drawn to the fact that many cases of multiple neuritis terminate fatally from superadded tuberculous infection. The infection of tuberculosis is one of the least virulent, and tubercle bacilli never secure a foothold except in states of profound depravity of nutrition, either local or general. If there were no other indications than this in the treatment of multiple neuritis to increase the patient's nutrition, we might still justifiably speak of the necessity of most careful attention to the patient's diet and his absorptive and eliminative systems. But considering that the degree and rapidity of his recovery stand in direct relationship to the nutritional state of the blood, the indications for such treatment are still more pointed. General admonition concerning diet is never sufficient in any case of acute nervous disease, any more than it is in typhoid fever. The patient must have a dietary, every detail of which has been scrutinized by the physician. Not that there are particular articles of diet that injure, except as they replace those that might be very helpful. Foods that have been shown empirically to be rich in tissue constructives, such as milk, yolk of egg, cereals, fish, and the leguminous vegetables, in combination with easily digested fats, should be the mainstay of the dietary. As a general rule, all alcoholic drinks, even though when taken in small quantities they facilitate tissue construction, are to be avoided. But to this rule there are many exceptions. For instance, in the post-infectious polyneuritides, there can be no doubt that small quantities of Burgundy or claret, sherry with yolk of egg, and in some cases even the malt liquors, may be taken for a short time with very beneficial effect.

After the patient has made such progress toward recovery that it seems advisable to allow him to indulge in voluntary movement, a plan of

re-education of the muscle sense and of co-ordination of purposeful movements should be instituted. No more useful plan can be formulated than the simple movements described in the chapter on locomotor ataxia, as recommended by Fraenkel. Oftentimes it is not necessary to utilize the more complicated ones. If the patient is a woman, the exercises for the hands may be substituted by endeavors at such handiwork as knitting, sewing, crocheting, and the like, or the practising of musical exercises. The relicts of an attack of acute multiple neuritis are oftentimes extremely tardy in their disappearance, and much may be done to expedite their departure by the continuance of these exercises.

This chapter would be incomplete without reference to the necessity of treatment directed immediately to the patient's mental sphere, or what may perhaps be called the *morale*. Two factors, possibly more, assist in making a profound impression upon the patient's consciousness. These are, in the first place, the agencies that are directly responsible for the polyneuritis act injuriously upon the cells of the brain cortex, and secondly, that the prolonged suffering which the patient experiences leaves memories of pain and impotence that are difficult to eradicate. In addition, the patient has become accustomed to certain physical shortcomings and enforced conditions, and no voluntary effort is made to overcome them. The wise and experienced physician will take all these into consideration, giving them greater or lesser prominence according to the psychical disposition of the patient, and be guided accordingly. In many instances no other therapy is required to overcome such manifestations of the influence of mind over matter than the assurance of the physician, coupled with insistence or command. On the other hand, the entire paraphernalia of mental therapeutics must be brought to bear upon the patient, in order to restore a proper equilibrium of the qualities of consciousness. In brief, it may be said that the keynote of the physician's relationship to his patient should be both inspiring and inspiriting.

Despite the greatest care in keeping the patient's limbs in the proper position during the inflammatory part of the disease, and the utilization of measures to prevent contractures and fixations of the joints during the later stages, both by massage and orthopædic appliances, deformity nevertheless sometimes results. To overcome these deformities, the aid of the surgeon should be obtained. The patient should be fully anæsthetized, and the contractures broken up, the ankyloses liberated, and the deformities overcome. Multiple tenotomies may be necessary in order to accomplish this end. The after-treatment, after the case has ceased to be a surgical one, consists of the installation of that plan of treatment already detailed to prevent the occurrence of deformities.

CHAPTER XXI.

THE TREATMENT OF PARALYSIS OF THE FACIAL NERVE—BELL'S PALSY.

Paralysis of the facial nerve is one of the commonest forms of individual nerve palsy. Its causations are manifold. The lesion upon which paralysis of the muscles supplied by the seventh nerve is dependent may be in the nucleus of the seventh nerve, in its intracranial course, at the internal auditory meatus, in the Fallopian canal, or of its trunk and branches after the exit of the nerve from the stylo-mastoid foramen. Lesion of the facial nerve nucleus in the pons causes paralysis known as nuclear facial palsy, while if the lesion is central to the nucleus the paralysis is called supranuclear. When the lesion is peripheral to the pons it is known as infranuclear paralysis or Bell's palsy. There is a congenital nuclear degeneration of the facial and oculomotor nerves which causes paralysis in the muscle supply of these two nerves which will not be considered.

Etiology of Facial Paralysis.—Paralysis of the facial nerve dependent upon disease of the nucleus is extremely rare compared with infranuclear paralysis. It is caused by inflammatory and degenerative processes within the pons, and especially those which are in relationship to diseased blood-vessels. Facial paralysis due to injury of the intracranial part of the nerve trunk is commonly dependent upon basilar meningitis, tumors in the posterior fossa, aneurism of the basilar arteries, trauma which injures the base of the skull, and diseases of the bones over and through which the nerve passes. Facial palsy caused by injury of the nerve at the internal auditory meatus and in the Fallopian canal is usually dependent upon disease of the internal and middle ear, disease of the petrous portion of the temporal bone, or fracture of the middle fossa of the skull. The commonest causes of facial paralysis, dependent upon inflammation or perineural exudation of the facial nerve after its exit from the stylo-mastoid foramen, are local refrigeration, exposure to cold draughts which impinge upon the trunk of the nerve at its exit from the skull, and exposure to general cold. Cold alone is sufficient to produce inflammation in the nerve, but usually there are some predisposing factors. These may be summarized under the caption of depreciators of vitality. Thus it occurs in those who have recently gone through some infectious disease, in those who are liable to outbreaks of rheumatic manifestations, in those who have constitutional diseases, such as diabetes, leukæmia,

and anæmia, and in those whose systems have been intoxicated by alcohol, lead, and arsenic. Its occurrence with mumps in children has often been noted. Peripheral facial paralysis is occasionally the result of trauma. This trauma may be from the forceps during delivery, or later in life it may be from a blow, a fall, or compression. Facial paralysis occurs from injury to the trunk of the nerve which causes a severance of its continuity accidentally or during an operation. Occasionally it has been observed after extraction of a tooth. In such instances it is not unlikely that a purulent process is at the bottom of it. The disease occurs oftener in late childhood and early maturity than at any other time of life, and in men oftener than in women. The latter is to be explained by the fact that men are more liable to exposure and to the factors that bring about rheumatic conditions, and also to the deleterious influences of alcohol and the metallic poisons with which they may come in contact in their occupations. The relationship of syphilis to facial paralysis is occasionally very striking. Usually facial paralysis of syphilitic causation is dependent upon involvement of the intracranial portion of the nerve by syphilitic lesion of the meninges, or syphilitic disease of the blood-vessels. Occasionally nuclear facial palsy occurs with manifestations of cerebro-spinal syphilis. Peripheral facial palsy may occur during the florid stage of syphilis apar from any evidences of focal syphilitic inflammation. I have seen tw cases of this kind within a year. There can be no question that faci paralysis is more common in those who are of neurotic inheritage an tendency than those who are not. In fifty consecutive cases of faci paralysis, an inherited or acquired neurotic predisposition was noted upward of fifty per cent.

Symptoms.—The symptoms of facial paralysis, especially the infra clear variety, are quite unmistakable when well developed. They v in distribution and in intensity with the part of the nerve implicated a the degree of the inflammatory process. When the paralysis is compl the forehead of the affected side is smooth and devoid of movement e on the greatest effort. The palpebral fissure is wide, and the eye can be closed either alone or in conjunction with the other eye. Lagophthalmus is almost invariably present if the temporo-facial branch is the seat of inflammation. On account of inability to close the eye, the conjunctiva is exposed to many unaccustomed irritants, and lacrymation and occasionally profound inflammation of the conjunctiva and cornea result. The naso-labial furrow on the affected side is obliterated, the cheek seem flat, the nasal aperture is somewhat enlarged, and the mouth is draw toward the unparalyzed side. When the patient attempts to whistle o to blow the angle of the mouth on the affected side remains depresse and unclosed. When the cheeks are puffed out, the one of the affected side is lax and unresistant. Food gets between the teeth and buccal mucous membrane, and must be dislodged with the finger. If the paralysis

of the cervico-facial is profound saliva often dribbles from the affected corner of the mouth. The patient complains of a feeling of stiffness or distention, especially around the carotid region, and occasionally of pain in the region of the upper branches of the cervical plexus and the trifacial nerve. If the lesion is of any part of the trunk up to the level at which the chorda tympani nerve is given off, which is well within the mastoid foramen, there is no disturbance of taste or hearing or difficulty in elevating the palate. If the seat of the lesion is beyond this point, that is, implicating that part of the trunk from which the chorda tympani is given off, there will be disturbance of the sense of taste, especially in the anterior two-thirds of the tongue on the side corresponding to the lesion, and with this the patient usually complains of dryness of the mouth. If there is paralysis of the palate, it is legitimate to infer that the lesion is peripherally to the point at which the large superficial petrosal nerve is given off. The most important feature of nuclear facial paralysis is the fact that the muscles of the upper face, that is, the orbicularis palpebrarum, frontalis, and the currugator supercilii, escape. Moreover, whereas in infranuclear facial palsy the occurrence of the reaction of degeneration in the nerve and in the muscles is prompt and typical, in nuclear palsy this phenomenon is delayed and atypical. At the end of the first week in peripheral facial palsy there is generally partial or complete reaction of degeneration in the nerve and muscles. An extremely important distinguishing feature of nuclear facial palsy is its association with other symptoms pointing to disease of the pons. Bilateral facial paralysis is rare, but it may occur from the causations mentioned above, in association with multiple neuritis, and as a part of a general extensive dystrophy.

Treatment.—The tendency of peripheral facial paralysis is toward spontaneous recovery, but many cases in which the lesion is profound and in which there are constitutional conditions not easily overcome the result is not so gratifying. In every case recovery may be facilitated and enhanced by careful, persistent treatment. The first duty of the physician is to search for the cause of the palsy and to counteract its activity and existence so far as possible. In the majority of cases the immediate cause, such as cold, trauma, and local inflammation, has ceased to be operative, but there is often some underlying constitutional condition which will need to be attended to. The existence of syphilis should be closely looked for, and if there are any indications of its presence active antisyphilitic medication, particularly the use of inunctions, should be begun at once. Cases associated with refrigeration and with rheumatic conditions are suitably treated by local hot applications, such as hot-water bags or fomentations, particularly if the patient is seen early. If there is some pain, and considerable tenderness over the course of the nerve, local blood-letting, by means of either leeches or cups, is decidedly beneficial.

If the patient is not seen until some time after the occurrence of the paralysis, the application of a blister just behind the ear and over the point of escape of the facial nerve from the stylomastoid foramen is oftentimes serviceable, especially in the cases associated with rheumatic manifestations in other parts of the body. Internally, the patient should be given salicylate of sodium in from fifteen- to twenty-grain doses, or salicylate of potassium in from three- to five-grain doses, either alone or combined with one of the diaphoretics. Such medication will usually cause prompt disappearance of the pain and sensation of stiffness in the side of the face. When much of the conjunctiva should be kept, and the patient advised to use an eye wash of a saturated solution of boric acid in rose water four or five times daily. On the slightest indications of keratitis or purulent conjunctivitis the eye should be treated antiseptically, and perhaps temporarily sealed with a patch which may or may not contain a watch glass.

After the paralysis has reached its completion, electrical treatment should be instituted. Some writers profess to believe that electricity is of no benefit in the treatment of facial paralysis, but my own experience is unquestionably opposed to such a view. It is beneficial, not only in the recent cases but in the case of long standing. It should be applied systematically, at first every day and then every second day, for from four to eight weeks without interruption, unless manifestations of the disease disappear before this time. The galvanic current is of greater usefulness, especially in the beginning, than the faradic, largely because a degree of irritability to the former is usually preserved long after faradic irritability is exhausted. The positive pole, connected with a large electrode, should be placed on the chest or other indifferent area, while the negative, connected with a small electrode, should be placed over the nerve trunk and a current of from two to three milliamperes is allowed to flow, while the cathodal pole is glided in labile fashion over the trunk of the nerve and its branches for from two to five minutes. The temptation is to use a stronger current than this and to prolong the *seance*, but this should be resisted. No benefit whatever is to be expected, nor is the rapidity of repair in the nerve enhanced from the use of a current sufficient to cause contraction of the muscles supplied by the seventh nerve during the first weeks of a peripheral facial paralysis. Neither should the physician be in a hurry to begin the use of the faradic current. In the first place, it is not so agreeable to the patient nor so well tolerated, especially by children, and in the second place, experience has shown that, during the earlier part of the disease, it is by no means so advantageous as the galvanic current. When the muscles supplied by the seventh nerve begin to recover their irritability to the galvanic current, this form of electricity may be used every day to throw them into contractions. An important point to remember in the electri-

cal treatment of facial paralysis is that no benefit need be expected from it after manifestations of contracture occur in the paralyzed side, and that it is idle to expect any results from the applications of electricity to the unparalyzed side, looking toward a counteraction of the contracture. I have never seen sufficient benefit follow the application of the continuous stabile galvanic current with the anode over the auriculo-mastoid fossa of the affected side and the cathode in the corresponding position on the sound side, such as is recommended by some electrotherapeutists, to warrant its recommendation.

Massage is an important adjuvant to electricity in the treatment of facial paralysis, and with the massage it is sometimes advisable to employ some simple orthopædic apparatus to overcome the deformity in the angle of the mouth on the paralyzed side. This can easily be done by having the patient wear a piece of bent celluloid or hard rubber in the shape of a hook, which slips just inside the angle of the mouth and is attached around the ear of the same side by means of a rubber band, for a few hours each day or, better still, during the night. The angle of the mouth is often the only part of the face which patients with facial paralysis do not recover complete control of, and the use of some such apparatus has seemed to me of real service in preventing this slight deforming relic of the disease. There is no particular method of giving massage in facial paralysis that is of signal advantage. Light rubbing over the course of the nerve, pinching and squeezing of the muscles, especially of the forehead around the eye and the naso-labial fold, are of service, both in increasing the blood supply of these parts and in indirectly exercising the muscles. When voluntary power begins to return to the muscles of the affected side the patient should be urged to practise moving the affected side while watching the results in a mirror.

The constitutional treatment of facial paralysis is sometimes of very great importance. Cases that show no tendency toward recovery after two or three weeks, especially under such local treatment as has already been detailed, should again be carefully investigated, in order to discover if there is any constitutional dependency of the paralysis. Many patients who develop paralysis of the seventh nerve are anæmic, underfed, over-worked individuals, whose recovery is very much more enhanced by the administration of medicinal and dietary restoratives, such as iron, arsenic, quinine, and an abundance of easily digested food, than by local treatment. On the other hand, overfeeding, deficient exercise, and the accumulation within the system of products which are the result of incomplete digestive and metabolic changes may exercise such a pernicious influence upon the peripheral nerves that the one which has been singled out for disease cannot recover its natural condition until these causes are overcome or eradicated. In such cases eliminative treatment, not reconstructive, is required. A similar statement holds true for the treatment

of facial paralysis which occurs after the infectious diseases, except that in these reconstructive therapy should always follow the administration of eliminatives. For instance, if the facial paralysis develops in the wake of any of the infectious diseases, small doses of calomel, followed by salines, would be called for; and then the patient should be put upon a tonic medicinal and dietetic plan of treatment. When the disease occurs with such constitutional conditions as diabetes and rheumatism, the treatment required, in addition to the local treatment already described, is that directed immediately against the existence of these diatheses.

If the palsy is due to trauma, no other treatment save the local, electrical, and mechanical treatment already detailed is called for, except in those instances in which there is some surgical condition, such as contusion or laceration of the soft parts which are amenable to mechanical repair, or in which a scar or splinter of bone and other like conditions are causing pressure upon the nerve. When facial paralysis accompanies fracture of the base of the skull—and it is a common accompaniment of such injury—no surgical treatment has any influence upon the degeneration of the seventh nerve. Disease of the middle and internal ear should receive most assiduous treatment, not alone to assist in the cure of the facial paralysis, but to overcome the constant source of danger of the development of intracranial abscess which such patients are liable to.

The prophylactic treatment of facial paralysis consists really in an endeavor to prevent recurrence. Prophylaxis of a first attack is quite impossible, infranuclear facial paralysis being practically an accidental condition. Recurring facial palsy, a not uncommon condition, is usually the result of an accident or constitutional condition similar to that which preceded the first attack. The efforts should therefore be to avoid these, the incumbency of the first resting largely with the patient, that of the second with the physician.

CHAPTER XXII.

THE TREATMENT OF NEURALGIA.

The term neuralgia is used to indicate the prominent symptom, pain, attending a number of different conditions. In other words, the name carries with it no particular reference to the nature of the disease, be it functional or organic, which causes it. Much objection has been brought forward against the term, as it signifies literally pain in the nerve, and as pain can occur in no other way, it is at once seen that the word algia is ample to cover the conditions now indicated by neuralgia. The use of the word algia in connection with the name of the part that is the seat of the pain, such as cephalalgia, brachialgia, cardialgia, etc., is becoming more common and should be encouraged. The term neuralgia has, however, become so fixed in ordinary and scientific nomenclature, and it has come to have such a definite application that no attempt should be made to substitute the more legitimate word for it.

Topographical Division of Neuralgia.—Neuralgia is a symptomatic pain dependent upon functional or organic disease of the sensory neurons, particularly of the peripheral sensory neurons. It is characterized by its occurrence in paroxysms, its localization to a single nerve—some one or all of its branches—and by a tendency to recurrence. It is classified topographically, according to the nerve involved, into trigeminal neuralgia; neuralgia of the cervical plexus, including occipital; brachial neuralgia; intercostal neuralgia; neuralgia of the lumbar plexus, subdivided into abdominal neuralgia, testicular neuralgia, crural neuralgia, and femoral neuralgia; neuralgia of the sciatic plexus, sciatica; neuralgia of the urogenital organs; coccygeal neuralgia; podalgia and metatarsalgia. Other subdivisions may be made if necessary, but these will be found to include most of the neuralgic conditions. Neuralgic pains occur with certain well-defined diseases, such as locomotor ataxia, but naturally such algias are not considered here.

General Etiological Factors.—Before taking up each of these conditions separately and enumerating the different modes of treatment to which they are amenable, it is necessary to say a few words about the general occurrence, symptomatology, and therapy of neuralgia. The fact that we are as yet ignorant of the nature of pain—that is, whether it is in itself an individual condition the occurrence of which is subserved by special nerves and pathways conducting to the central perceptive mechanism, the sensorium, or whether it is a quality of other sensa-

tions—prevents us from speaking at any length of its pathogenesis. From observation of cases and study of statistics bearing on the occurrence of this symptom, we learn that the principal factors in its etiology are heredity, age, sex, exposure, excesses, and factors that lower vitality and depreciate the nutritional power of the blood. Direct heredity occurs in about twenty-five per cent of all cases of neuralgia, it matters not what its topical distribution may be. A corresponding percentage, or perhaps even greater, shows indirect heredity; that is, some branch of the immediate family manifests one or more of the degenerative or acquired neuroses. Neuralgia is most rife during the years of greatest physical and mental activity; the period of fullest maturity, from twenty to forty. It is rare in childhood, and scarcely ever occurs after the end of the sixth decade. It has a special tendency to appear at one of the physiological epochs, the establishment of the sexual functions, denoting the onset of maturation; or the decay of these functions, pointing to the passing of it. It is much more common in males than in females, a fact that is explained largely by the greater physical and mental exigencies with which the life of the former is filled. This does not entirely explain the occurrence, however, for in latter years when the weaker sex has so conspicuously usurped many occupations for which men were supposed to be exclusively fitted, the proportion of patients who suffer from neuralgia has not been materially changed. In women the occurrence of neuralgia has relationship frequently not only to the menstrual functions, but to the entailments of maternity, including lactation.

It is unnecessary to enumerate the factors that may help to depreciate vitality and nutrition. They might all be legitimately spoken of as indirectly provocative of neuralgia. Directly, however, they cause anæmia, dyscrasia, or cachexia, upon which the neuralgia is immediately dependent. In this way the infectious diseases may precede an attack of neuralgia and justly be considered the cause of the latter. It is probable that the infectious diseases may cause neuralgia by their infections or intoxications acting directly upon the sensory nerve, and not indirectly through the blood. The fact that neuralgia occurs with influenza and malaria is particularly suggestive of this view. It may be that the intoxications and infections of the acute diseases acting on the sensory nerves are manifest symptomatically according to the intensity with which the nerve is involved. In other words, a mild degree of post-infectious activity on the central nerves may result in neuralgia, whereas a severer degree may cause the phenomena of sensory neuritis. In the same way it is possible to explain the influence of such intoxications as alcohol, tobacco, lead, mercury, and arsenic. These substances are all capable of causing neuralgia, and frequently they play a much more important part than is generally believed. Their power to cause neuritis is pointed out in another chapter. Autointoxication in the causation of neuralgia is likewise a

subject that might be discussed at some length; but we do not possess many actual data, aside from those based on clinical observation, which can be used to support positive assertions as to the frequency of autointoxication in causing neuralgia, or the mode of its action. Clinical experience, however, is unequivocal on this point, and especially that part of it which is the result of therapeutic tests. In many cases of neuralgia, especially those forms not dependent upon organic disease of the sensory neuron, the most gratifying results follow the administration of substances which act solely upon the eliminative avenues. In such cases it is safe to infer that pain has been the result of something in the system which the eliminative has removed.

The rôle played by cold and dampness in causing neuralgia is a leading one. It is abundantly proven by statistics that this symptom is more than twice as frequent in winter and in spring than during the other two seasons. Moreover, in many cases of neuralgia, particularly facial and cervical neuralgia, the effect of cold in precipitating an attack is very obvious. In the same way it can be shown that neuralgias are very common in those whose occupation or duty necessitates exposure to changes of climate and inclemencies of weather.

Neuralgia may be the direct expression of injurious encroachment upon some part of the peripheral sensory neuron, either from inflammation of the nerve and its immediate environment, or from pressure, such as may result from the contraction of a cicatrix; or the development of a new growth in the hard or soft parts; or from external pressure. Syphilis is often responsible for neuralgia, which occurs immediately in this way. There may be no syphilitic or parasyphilitic implication of the sensory nerves themselves; but syphilitic disease of a canal through which sensory nerves pass, or of hard and soft parts traversed by these nerves, may produce neuralgia by encroachment upon the nerve. If the encroachment is great enough, it may cause different degrees of destruction in the nerve. A very similar explanation holds good for the neuralgia that occurs secondary to trauma. The trauma may be of sufficient severity to produce change in the nerve itself, or change in the environment of the nerve, either of which is manifest by pain. On the other hand, a trauma may cause neuralgia without apparent lesion of the nerve or of the environment of the nerve, and this form of neuralgia is not easy to interpret. It seems to be a fact that the immediate antecedent of neuralgia caused by trauma, which is not severe enough to produce demonstrable lesion, depends upon changes of nutrition in the peripheral sensory neuron. These are analogous to the alterations of nutrition which trauma produces in the motor nerves when it causes the transient motor palsy known as night palsy and the lighter degrees of pressure palsy. The transientness of these palsies shows that there are no organic alterations in the nerve. Alterations of the nutrition in sensory neurons may like-

wise be considered as the basis of those neuralgias which occur in organs or tissues that have been put to excessive use. It is well known that indulgence in sexual excesses is often followed by spermatic or testicular neuralgia, and on the other hand prolonged and fatiguing use of the extremities is likewise followed by pain, even though no organic change be present to account for the neuralgia. It may be contended that in such neuralgias as tarsalgia there is a tension put upon the ligaments and the supportive structure of the feet that directly causes the pain, and this may be a fact. It nevertheless remains that such conditions cannot be demonstrated, and we are forced to accept the theory that exhausting influences may cause trophic changes in the sensory nerve, which are manifest by pain. Some such explanation as this must be given of the neuralgias occurring with the functional diseases of the nervous system, which are by no means uncommon.

General Symptomatology.—The symptomatology of a symptom seems rather absurd, but the variations in the symptom itself and its accompaniments are so great that they require particular description. The character of the pain depends upon the cause, nature, seat, and intensity of the neuralgia, while the complaint of the patient varies with his power to portray by word or action the degree and intensity of his suffering. The pain, almost invariably paroxysmal in its occurrence, is described as lancinating, boring, gnawing, tearing, or lightning-like, as the imagination or experience of the individual may furnish a simile. The exacerbation may be for only a second or it may last for several minutes, a degree of pain being felt during the intervals that is comparative comfort contrasted with that at the height of the paroxysm. It is manifest in a single nerve or in one of its branches, and radiates as a rule from the root toward the periphery. Generally it is indicated by the patient to be in the superficial structures, but in many cases, such as trigeminal neuralgia, it is described as being very deep seated. As a rule, the pain is increased by movement, by exposure to transient and varying degrees of cold, by all kinds of mental irritation, and by anything that lowers resistance. For instance, sleeplessness is a very potent cause to increase the intensity and the frequency of the pain. On the other hand, it is soothed and made more tolerable by the opposite of these factors, and occasionally by the continued application of a uniform degree of cold. The occurrence of neuralgic paroxysms is often preceded by local and premonitory phenomena and by ancillary symptoms. Patients who are accustomed to attacks of neuralgia are usually able to tell by definite feelings of indisposition manifest in different ways, that they are in for a siege; while during an attack there are often vasomotor, secretory, and trophic disturbances, depending upon the part in which the neuralgia is manifest, and upon the implication of sympathetic nerves directly or reflexly. These vasomotor symptoms may consist in blanching of the

skin, of an angioparetic condition accompanied by diminished or increased secretion of cutaneous and mucous-membrane glands, and by changes in the general circulation, most strikingly apparent in the extremities. Occasionally such symptoms as nausea, vomiting, expulsion of the contents of the bowels and bladder, vertigo, specks before the eyes, and even some obscuration of the mental faculties, may occur. These are conditioned directly by the overwhelming effect of the pain upon the sympathetic nervous system and are in reality nothing less than manifestations of shock.

The objective accompaniments of neuralgia are constant and of much diagnostic significance. The most important of these are painful points in the course of the nerve manifesting the pain, which are usually described as Valleix's points, after the physician who called attention to them in such a way that they became more universally recognized than from the descriptions of preceding writers. If a nerve which is the seat of neuralgia is subjected to pressure at different points along its course, the patient will complain that it is sensitive, and when pressure is made at certain points he will cry out with pain. These painful points are principally at a situation where the nerve emerges from a bony canal or where it passes through a fossa, or at some other point at which the pressure of the finger is opposed by a firm resisting surface, such as bone. These painful points will be considered in detail under the individual forms of neuralgia. Here it need only be said that it is yet debatable whether the pain thus produced is caused through the nerve itself or the nervi nervorum. Other objective accompaniments are hyperæsthesia of the skin and mucous membrane supplied by the affected nerve, anæsthesia, usually never complete and more evident on tactile stimulation than on thermal and electrical stimulation. Often the neuralgia is accompanied by tonic muscular contractions, more rarely by clonic phenomena that are usually thought to point to an irradiation of the painful stimuli from the peripheral sensory neuron to the peripheral motor neuron.

Patients who suffer many attacks of neuralgia are likely to become changed in disposition, in resistance to all forms of painful stimuli, and, in short, in increased susceptibility to all forms of physical and psychical demands. Some of these are to be interpreted as the direct results of the disordered general nutrition which suffering induces; but a part of it, on the other hand, is the immediate effect of the suffering upon the general morale of the patient. This disorganization of the patient's morale, or courage, or mental resistance, or call it what one will, must be taken very seriously into account in the treatment of every case of recurrent and persistent neuralgia.

Treatment.—The treatment of neuralgia resolves itself into two necessities: First, and by all means the most important to the patient, at least

for the time, is the relief of the pain; and second, the overcoming of the conditions on which it is dependent, therefore the prevention of its recurrence.

Mere enumeration of the medicines which have been suggested for the relief and cure of neuralgia would fill a number of pages. I shall therefore be obliged to limit myself to a brief consideration of those that are known to be of real value. Naturally, the most powerful substance in the relief of neuralgic pains is opium. It requires little argument, however, to convince even the most venturesome that it is the last drug that should be resorted to. Neuralgia is peculiarly a condition that favors the ready acquisition of the morphine habit, from the fact that it is chronic and tends to recur. The administration of opium merely temporizes, and the same conditions that call so loudly for it will recur and with greater force later on. The patient himself will be less able to resist clamoring for it, and the physician will find the apparent indications for its use more insistent than they were at first. The first step, therefore, is the fatal one, and it should be delayed so long as there is a leg to stand upon. In the chapter on headache, many of the drugs that may advantageously be used instead of opium have been enumerated, and the combinations which are there given are often as successful in relieving neuralgia as they are in causing the disappearance of headache. The more important of these drugs, it is well known, are antipyrin, phenacetin, exalgin, antifebrin, lactophenin, and the salicylate group. It needs only to be borne in mind that all of these substances are depressants as well as analgesics, and that they must be given cautiously, often in connection with diffusible stimulants, such as caffeine, ammonia, ether, and camphor. When they have been found to be useless, one should resort to the less harmful alkaloids of opium before finally determining to give morphine. These are codeine, narceine, and thebaine, and drugs that are known to have the special property of benumbing sensory nerves, such as aconitine, gelsemium, Croton chloral, butyl chloral, atropine, and cocaine. These medicaments have earned a reputation for the relief of certain kinds of neuralgic pain, such as trifacial neuralgia and cervico-occipital neuralgia, and they may well be considered under these headings. When these drugs fail to give relief, it is cowardly not to cut short the patient's suffering by the administration of morphine. If the necessities of the case do not call for immediate relief, it is advisable to do this in some other way than hypodermatically. Administered in the latter fashion it makes a certain mental impression that it is best to avoid. When atropine is combined with morphine, it not only has a better effect in relieving pain, but it prevents the disagreeable after-effects which follow the administration of morphine. It should always be kept in mind in prescribing morphine for the relief of severe neuralgia that the dose must be proportionate to the severity of the suffering. It is far better to give one large dose,

which will quell the pain for a number of hours, during which time accessory medication and application may be indulged, than to give a number of small doses. Moreover, the administration of sufficient narcotic in one dose to relieve the patient for a considerable length of time may be gratifyingly supplemented by some simple sleep producer, such as sulfonal or trional, that will carry the patient through an entire day or two until the force of the neuralgia has expended itself.

Much has been written by enthusiasts about the efficacy of psychotherapy in neuralgia. It is difficult to make a just estimate of its worth, because, as I have already said, the psychical element enters into the causation and manifestations of neuralgia to a degree varying with each individual, and because, moreover, psychotherapy is such a flexible embodiment. It may mean merely the inspiring presence of the one whom the patient has been accustomed to use as a shield from pain, or it may mean an impression upon the supraliminal consciousness that carries it into a state of complete inactivity. In any case, the benefit which may possibly be expected from it should be welcome. It is more efficacious with patients who have suffered for a long time and who contract a pain habit or who become hysterical from long suffering, than with any others.

The physician finds a large field for usefulness when face to face with neuralgia, in the treatment of the underlying causes of which it is a symptom, for when they are successfully combated the symptom ceases. In fulfilment of this mission, he not only directs his endeavors toward removing the apparent causation, whether it be an intoxication, infection, dyscrasia, or cachexia or a lesion accessible to surgical interference, but to the fortification of the general vitality, by the use of all those measures known to increase nutrition and make it more stable, while at the same time he employs physical measures, such as electricity, massage, external applications, such as compression, heat and cold, baths, subcutaneous injections, as carbolic acid, ether, and strychnine. The indications for special medication directed toward the relief of the individual causes must be determined for each case. In one it may be the administration of quinine to counteract malaria, in another mercurials and iodide of potassium to battle with syphilis, in another colchicum for its selective action in gout, and in another the administration of iron and a reconstructive dietary to overcome anæmia. None of these is sufficient by itself to overcome the neuralgia. Its action must be aided by a building-up plan of treatment.

The Use of Electricity in the Treatment of Neuralgia.—One of the most important measures in the treatment of neuralgia is electricity. In the chapter on electricity, it is said that this agency is of incomparably greater value as a diagnostic than as a therapeutic agency, but here it needs be said that it is in neuralgia that it finds one of its most important and efficacious usages. It is applied in the shape of

galvanism, faradism, or static electricity. The galvanic current and the rapidly interrupted faradic current obtained from a long coil of extremely fine wire are most efficacious. The mode of application of the galvanic current is the labile method, the irritating pole (that is, the negative pole) being always placed over some indifferent part of the body, while the anode (the positive pole) is applied rubbed up and down over the course of the nerve manifesting the pain, and finally, the *séance* terminated by the application of this pole directly over the most painful point of the nerve for from one to two minutes. What has already been said concerning the necessity of having a rheostat and galvanometer for the regulation and measuring of the current should be borne in mind in this connection. Without these appliances the galvanic current should never be used as a therapeutic agent, especially in neuralgia. The intensity of the current will depend somewhat upon the part of the body to which it is applied. When the neuralgia is of the cephalic extremity, a current of two milliamperes is all that will be tolerated, while for sciatica, for instance, a current of from six to ten milliamperes may be advantageously administered. As a general rule, however, more benefit is to be obtained from the prolonged application of a weak current (two to four milliamperes for from one-half to two hours daily) than from a strong current for a short time.

The faradic current obtained from a long, closely wound coil, sometimes gives most striking relief in neuralgia, especially in neuralgia associated with dyscrasia. Usually, its application through the ordinary electrodes is more satisfactory than through the brush electrodes which oftentimes cause irritation and accession of the pain. In some cases it may be advantageous to allow the current to pass through the body of the physician and therefore applied immediately by the operator's hand. Undoubtedly the element of suggestion here is very potent. Static electricity, if given with sufficient intensity and duration, is also frequently of great service in the treatment of neuralgias, particularly those that are deep-seated, such as neuralgia of the lumbar and sacral nerves. The mode of application is either by large sparks directly to the part in which the pain occurs or by means of the roller electrode.

The utility of massage, and it is oftentimes great, in the treatment of the various forms of neuralgia will be considered under the individual headings. Here a word must be said concerning the advisability of adopting surgical measures in rebellious cases. These consists of nerve stretching, the bloodless form or by operation, neurotomy, neurectomy, and the resection of the sensory ganglia, such as the Gasserian ganglia for uncompromising trifacial neuralgia. All these measures have had their eulogists, and at different times waves of enthusiasm concerning their efficacy have swept over the medical profession. Unfortunately, the casual observer has seen only the crests of the waves, unmindful of the

troughs between them. The trough existed, and oftentimes has been far more conspicuous than the waves. No objection can be offered to the trial of nerve stretching when this can be done without operation, nor is there any considerable danger attending the operation by exposing the nerve and stretching it. It must, however, not be forgotten that resection of a nerve, particularly of such nerves as the trigeminus, may be followed by very serious paralytic and trophic phenomena which must be taken into fullest consideration when the matter is being laid before the patient. Further details of these procedures, as well as of subcutaneous injections, external applications, baths, etc., will be found under the special subdivisions of this subject.

Some neuralgias are rebellious to all forms of medicinal and mechanical treatment, and the aid of the surgeon must be sought. The indications for operation will be considered under the individual headings. Chipault has recently recorded an example of the great benefit that may attend surgical interference. The patient had suffered for four years with an unbearable neuralgia of the right arm, which had resisted every form of treatment, including repeated section of the ulnar nerve. The root of the eighth cervical nerve was cut intradurally. Two and a half years later, when the case was reported, there had been no recurrence of the pain. There were no permanent sensory disturbances, but there was some atrophy of the hypothenar eminence.

CHAPTER XXIII.

THE TREATMENT OF TRIFACIAL NEURALGIA.

The fifth nerve or some of its branches is often the seat of neuralgia. Such neuralgia may be symptomatic of a number of conditions, principally those that cause hæmolysis and those that interfere with hæmogenesis, or it may be indicative of organic change in the nerve itself. It has not always been recognized that trifacial neuralgia may be of as many forms, both in its clinical course and in its termination, as there are causes of the condition. Even to-day the therapy of the affection does not take the truth of this into sufficient consideration. The term trigeminal neuralgia is used synonymously with tic douloureux, prosopalgia, and Fothergill's painful affection of the face. It would, however, be wise to restrict the use of the designation tic douloureux to indicate an affection of the fifth nerve occurring in middle or advanced life, especially in those who have inherited or acquired a tendency to neurotic manifestation, which has rather a constant clinical course and termination. It is one of the most painful conditions that afflict mankind, and happily it is comparatively a rare disease. I say disease advisedly, for unlike the ordinary neuralgias of the trigeminal nerve it is not a symptom but a pathological and clinical entity.

Trifacial neuralgia has occupied a conspicuous place in the annals of medicine for many hundred years, and tomes upon tomes have been written about it. The early Latin writers called it tortura oris. Some idea of the widely diverging conceptions that different writers have had of this condition may be inferred from the published reports of the efficacy of certain plans of treatment and of certain drugs. Contrast these with the status of the therapeutics of this affection to-day and the result is extremely paradoxical. In the same way the diametrically opposed teachings concerning the value of electricity in the treatment of this condition may be explained. There can be no doubt whatsoever that electricity is of considerable value in overcoming certain forms of trifacial neuralgia—the symptomatic varieties—but in true tic douloureux, on the other hand, it is quite useless.

The morbid changes in the primary sensory neuron, be it of the periphery or of its arborizations in the Gasserian ganglion, upon which the neuralgia is dependent have not yet been satisfactorily determined. Undoubtedly in many instances the nerve is organically diseased, even in

the symptomatic form, and this state may have been brought about by injurious agencies acting directly upon the nerves or indirectly through the blood-vessels. Trifacial neuralgia may be merely an indication of disordered function of the nerve, which in turn may be dependent upon many factors. Finally, it may be a manifestation of a degenerative neurotic state somewhat akin to epilepsy and migraine. Long-continued perversion of function may lead to organic change in the nerve and ganglion.

Trifacial neuralgia is a symptom of functional or organic affection of some part of the fifth cranial nerve or the Gasserian ganglion, characterized by pain in one or all of its branches. In the symptomatic form the pain is more or less continuous, but in the degenerative form it usually manifests itself in paroxysms varying in intensity from a slight twinge up to the most agonizing torture. True tic douloureux is almost invariably of the second and third branches, the first branch being spared. In symptomatic trigeminal neuralgia the ophthalmic branch, and particularly its terminal filament, the supraorbital, is affected in the majority of instances, constituting about seventy per cent of all cases of facial pain. Occasionally a local causation may be found to account for it, such as inflammation of the frontal sinuses, latent otitis, or inflammation of the mastoid process, but generally it is the expression of some constitutional condition or neural exhaustion. It has a striking tendency to recur, and this, in addition to the fact that it often occurs with malarial affection, has given it the name brow ague. Pain in other branches of the ophthalmic nerve is rare. The eyeball may be the seat of pain, but when it is confined to this organ there is usually some local condition to account for it, such as defective refractive media, muscular insufficiencies, inflammatory condition, or glaucoma. The second branch or supramaxillary is affected more frequently than the third, or intramaxillary. The pain may be manifest in the entire distribution of any one of these branches, or it may be confined to one of their subdivisions, such as the supraorbital branch of the ophthalmic, the superior alveolar, or infraorbital of the second trunk, or the mental branch of the third division of the trifacial. Usually, the neuralgia does not involve more than one of the divisions of the trifacial nerve. Occasionally the first and second divisions are simultaneously affected, and very rarely are all the branches, including the motor (causing masticatory paralysis), implicated. Sometimes the neuralgia shows itself first on one side of the face, and, after a variable time, on the other, either before or after the pain has ceased on the side first affected.

Etiology.—Aside from the general etiological factors which have been enumerated as causative of neuralgia, trifacial neuralgia seems to have a close relationship to a few individual conditions. These are: (1) Disease or disorder of some of the organs and cavities to which this nerve is distributed, such as the nasal and orbital cavities, the alveolar processes

and their communications, and the organs of special sense. Two cases of inveterate pain in the face occurring in men fifty and thirty-eight years respectively, cured by removal of extensively diseased middle turbinated bone, have recently been reported by Mayo Collier. (2) Conditions which operate directly on the nerve itself, particularly refrigeration by exposure to draughts or intense cold; blows or other forms of trauma, and direct encroachment upon the nerve, particularly at a foramen of exit or in a bony canal through which it passes; by inflammatory or exudative condition, the most common excitant of which is syphilis, which causes an inflammatory reaction in the early stages and a degeneration in the latter. (3) Arteriocapillary fibrosis, and (4) the inheritance or acquisition of a tendency to neurotic degeneracy. These are the principal ones. What has been said concerning the influence of heredity, instability of nutrition and depression, physical and mental strain and overactivity, and the harmful effects which infections and intoxications have upon peripheral sensory nerves, in the previous remarks on the general etiology of neuralgia, apply to trifacial neuralgia. A word in addition is necessary to call attention to the relationship existing between chronic constipation and the occurrence of trifacial neuralgia. That there is such a causal relationship statistics abundantly prove, but it is not satisfactorily interpreted. Most writers attribute the causation of trifacial neuralgia accompanying and apparently dependent upon constipation to autointoxication. But this does not entirely explain it, for none of the sensory nerves of the body seems to be susceptible to such an intoxication. The four important factors are: those above mentioned, viz.: (1) Disease or disorder of the cavities and parts to which the trigeminal proceeds; (2) trauma, and encroachment upon the nerve; (3) degenerative disease of the blood-vessels, and (4) interstitial and parenchymatous change in the Gasserian ganglion. The clinical varieties of trifacial neuralgia, including the intensity of the symptoms, the duration of the paroxysms of pain, and the amenability of the condition to treatment, stand in very close relationship to the one of these four conditions with which it develops, and it can be readily seen that the form of treatment which might be successful in one variety would have no beneficial influence whatever on any of the others.

Symptoms.—The essential symptom is pain—the pain of genuine tic douloureux. In symptomatic trifacial neuralgia the pain often begins as a mild headache, limited to the distribution of the supraorbital nerve. This headache gradually increases until it is of almost intolerable severity. It occurs in paroxysms, and it is of very variable intensity. Sometimes it is preceded by premonitory phenomena such as intolerable itching in the domain of the nerve which later manifests the pain, paræsthesia, formication, and more rarely by a sense of unwieldiness or fixation of one side of the face. On the other hand, patients often are awakened during

the night with a painful sensation as if a hundred heated needles were being driven with superhuman force through the side of the face into the tissues of the upper jaw. This agonizing pain lasts from a second to a minute, and is then followed by an interval of comparative rest, during which the patient is in mortal terror of a revisitation. Some sufferers describe the pain by comparing it to that which might be produced by boring into the eye with a large auger, or of drilling into the nerve of an inflamed tooth, but the majority find themselves too poor in language to express even a moiety of their suffering. Its intensity may be gathered by witnessing their agony during the paroxysms and the evidences of fear and terror during the intervallum. Oftentimes the pain is so severe that the patient becomes delirious and maniacal at the height of the paroxysm, especially if the paroxysms are of frequent occurrence. Under such circumstances they may commit deeds of violence against themselves or others, for which they are by no means responsible. On the other hand, occasionally suffering so demoralizes the patient that he cannot keep up the courage to face the liabilities of recurring paroxysms, and deliberately suicides. The danger of this should not be forgotten by him who essays to treat a case. The paroxysms are often associated with muscular twitchings. The entire head may be agitated by a number of clonic vibrations, or the twitching may be confined to the muscles supplied by the motor branch of the fifth nerve, occasionally to those innervated by the seventh nerve. Movements of all kinds, active or passive, increase the pain, and the patient learns early to avoid any muscular action, such as is involved in speaking, laughing, coughing, eating, sneezing, turning the head, and walking. He stands in mortal fear of draughts and exposure, and of effort of any kind which he has learned to know are sufficient to precipitate an attack.

Vasomotor disturbances rarely precede, but often accompany the paroxysms of the pain, and often continue in the intervals between the paroxysms. These may consist of blanching of the skin in a narrowly confined area of the face, ear, head, neck, and of the antithesis of this condition, viz., a suffusion, with apparent distention of the blood-vessels associated with subjective sensations of tension and heat. With this condition there may be, and often is, some disturbance of secretion in the glands of the skin and orbit, and of the nasal mucous membrane and salivary glands. There is no regularity in the appearance of these manifestations, however, nor do they form an integral part of the symptom complex. Trophic disturbances, such as loss of color of the hair and beard, neurotic inflammation of the skin, in the shape of herpes zoster, an analogous condition of the conjunctiva, known as ophthalmia neurotica which occasionally leads to very profound destruction of the cornea, may all occur. More profound trophic manifestations,

such as ulceration and sloughing of the soft parts, alveolar contraction and atrophy, with consequent loss of the teeth, and facial hemiatrophy, happily occur very rarely, and their occurrence indicates almost invariably serious disease of the Gasserian ganglia. During and immediately following the attack there is usually considerable hyperæsthesia in the course of the nerve which is manifesting the pain, and the nerve is sensitive when firmly pressed at some point at which it approaches the surface or at which it escapes from a canal or a foramen. The significance of such tender or painful points in neuralgia has already been considered. On the other hand, generalized pressure over a considerable surface, such as by the palm of the hand, is often grateful. Usually, there is no dissociation of sensation and very rarely anæsthesia. The presence of the latter should prompt one to search immediately for organic disease of the pons and oblongata.

The duration of an attack is very variable. In the beginning it rarely lasts for more than a few hours, but the paroxysms may recur every few minutes during this time. On the other hand, when the disease is chronic and of what may be called a degenerative type, the attack may last for weeks, the paroxysms occurring once or less often in the twenty-four hours. They are very liable to occur between midnight and sunrise, thus adding to the misery of the patient by preventing sleep. Occasionally individuals will have attacks only during certain seasons, such as the spring, and after a few weeks, during which time the paroxysms may be of daily or bi-weekly occurrence, they cease and do not recur until the same time the following year. There would seem, however, to be no rule for the frequency or time of their occurrence, except in so far as they have relationship to the etiological factors that have been mentioned.

Before taking leave of the symptom complex of trifacial neuralgia, a word must be said anent the state of physical and mental depravity into which sufferers with trifacial neuralgia quickly fall. Although they may be strong in mind and body, brave and valorous in their resistance to pain and suffering, a few attacks often suffice to shatter their morale and courage so that they become depressed, unconfident, lacking in hope, and in a general way quite incompetent to decide what is or is not to their advantage. This mental state must be continually taken into account in treating the patient. Naturally, there are very many cases of trifacial neuralgia, happily so, in which the pain is so moderate that the patient can keep to his work. In instances of this sort the patient's general neural and mental tone may not be discernibly lowered.

Treatment.—The first indication in the treatment of trifacial neuralgia is to discover its cause, and the second indication is to remove it, overcome it, or render it non-operative, all of which may be summarized under the designation of causal treatment. In the mean time, it may

be necessary to relieve the patient's suffering; in fact, it is oftentimes incumbent on the physician to do this before any consideration is given to the cause of the pain or its removal. Bearing this in mind, I shall speak first of the causal treatment. It is not sufficient to say that the state of the buccal cavity, the nasopharynx, the eyes, ears, and accessory cavities be investigated, and any abnormalities which they present be corrected. Although this is entirely true, some physicians seem to proceed on the idea that the pain must have its origin in one of these, and forthwith proceed to treat it. It is thought necessary to emphasize this, because my experience has been that many patients coming under treatment for trifacial neuralgia have had some or all of the teeth extracted from that side of the superior maxillary in which the pain is situated, on the supposition naturally that the pain which is referred to the teeth was due to decay of these organs. Although tic douloureux may sometimes be caused by a chronic alveodental arthritis and defective development of the wisdom teeth which leaves the gums exposed, these are so rare that they need not be considered. Moreover, it is not uncommon to find that often the nasopharynx and eyes have been under prolonged treatment when the pain is referred directly to these parts, even though there are no evidences of local disease which demand such treatment.

The general condition of the patient's health having been investigated, the indications for giving antirheumatic, antisyphilitic, antimalarial medication must be considered. If the attacks of pain occur periodically, and particularly if the neuralgia is of the first branch of the trigeminal, careful investigation of the blood should be made for the malarial plasmodium. If plasmodia are found, quinine should be given in quantities sufficient to render the parasite quiescent, and then the general nutritional tone so restored by means of the administration of arsenic, iron, and the application of some form of physical therapy, that the plasmodia will be removed from the system. The most satisfactory way of administering quinine will vary with the intensity of the infection and with the constitution of the patient. It is well known that in malarious localities and countries the same person will tolerate incomparably larger quantities of quinine than when in a locality free from malarial infection. Happily, quinine has the capacity to blunt the conductivity of the sensory nerves, and therefore acts as a pain reliever, so in malarial neuralgia it fulfils a double indication. This latter quality may account for the fact that in some cases of trifacial neuralgia, even in which there is no malarial infection, the administration of quinine is often of benefit. The same may be said of arsenic, which is really a potent measure in the cure of many neuralgic affections. It should be given either in the shape of Fowler's solution and combined with one of the simple bitters, such as cinchona, and the

dose increased from three or four drops three times a day up to fifteen or twenty drops, and perhaps even higher, or arseniate of soda. That is, it should be increased until its physiological action is well manifest. If there seems to be a rheumatic element in the attack the latter praparation may be given in connection with alkalies.

Without a history of syphilis or some indications of syphilis that are discernible to the eye, it is difficult to conclude that a trifacial neuralgia calls for antisyphilitic medication, even though some of the accessory occurrences of the symptom suggest the syphilitic origin of the neuralgia. When, however, the previous infection by syphilis is unquestionable, and especially when there are any demonstrable conditions pointing to syphilis, there is urgent necessity for inaugurating treatment by mercury and the iodides, providing, of course, the neuralgia is not a parasyphilitic expression. Usually, syphilis causes trifacial neuralgia by producing a periostitis of one of the canals or foramina through which the nerve or some of its branches pass. This, at least, is true of the neuralgias occurring in the early career of the affection. Those that accompany late manifestations of syphilis are due primarily to degeneration which it causes in the blood-vessels from which the disordered nerve receives its nutrition. Such cases may demand mercurial treatment, but they require the administration of iodide of potassium or of sodium, and the vascular dilators more urgently than they do the former. However, every case of syphilitic endarteritis, it matters not how far removed it is temporarily from the initial infection, calls for mercurial medication. In two cases of trifacial neuralgia occurring in syphilitics, I have seen benefit result very quickly when the inunctions of mercury were applied to the side of the neck and face and behind the ear. It may be that the rubbing and massage had some influence in accelerating the response of the pain to this treatment.

Trifacial neuralgias which occur in the wake of the infectious diseases, such as influenza, pneumonia, and typhoid fever, as well as those occurring after refrigeration and with the vascular and articular phenomena of rheumatism, are very often quickly ameliorated by the administration of the common analgesics and antirheumatics: phenacetin, antipyrin, antifebrin, salipyrin, and the salts of salicylic acid. The dose of each one of these substances must be determined for the individual case, but it needs to be emphasized that larger doses of almost any one of these substances can be given in neuralgia and with better results than in any other condition. Their administration should be associated with eliminative treatment, more particularly by the giving of substances that stimulate the activity of the kidneys, the bowels, and the skin. If there is chronic constipation, it should be vigorously combated, for a well-established relationship exists between this condition and the occurrence of trifacial neuralgia. Whatever means may be taken to overcome it, it is

well to bear in mind that some intestinal antiseptic can be advantageously given at the same time, such as, for instance, the following formula:

℞ Ext. cascara sagrada, ... ʒ ss.
Ext. nucis vomicæ, ... gr. ij.
Ext. aloes, ... gr. iij.
Ichthyol., ... gtt. xvi.–ʒ ss.
M. ft. caps. No. xii. One capsule to be taken three times a day after meals.

Very satisfactory results in overcoming chronic constipation by the use of water have been gained by Gussenbauer, who directs that it be utilized in the following way: The patient receives a cold-water clyster, administered in the ordinary way, with a syringe, every day. In severe cases the injection is introduced by means of a rectal tube. In addition to this, the abdomen is rubbed for several minutes once a day with cold water, and for the remainder of the time the abdomen is covered with a Priessnitz compress or Neptune girdle. Cold water may also be applied over the entire body from the palm of an attendant's hand. These regulations are kept up until the bowels become regular in action and copious in the amount of their discharge. If this result cannot be obtained from the measures mentioned and from a regulation of the diet, it is recommended that the patients go upon a full milk diet. Following this plan, the author's results have been very gratifying. Measures looking toward the improvement of the patient's general nutrition, whether they consist of administration of iron, cod-liver oil, etc., the application of hydriatics in the way already described as of benefit in neurasthenia, inducing the sufferer to make a change of climate and of surroundings, must be adapted to each case. As a general rule, patients with any form of neuralgia are better when they live in a moderately warm, dry climate. This allows them to be out of doors most of the time. Even a temporary sojourn in such a place is followed by an improvement of the general nutrition and by amelioration and possibly disappearance of the neuralgia.

Under causal treatment there remains to be considered the treatment of trigeminal neuralgia occurring with arteriocapillary fibrosis. This form of vascular degeneration is probably responsible for more cases of trigeminal neuralgia occurring in the latter third of life than all the other enumerated etiological conditions combined. The clinical form of tic douloureux that accompanies such conditions is somewhat different from that associated with refrigeration, trauma, intoxications, and after infections. It may not be of such unbearable severity, but the paroxysms are more likely to be of frequent occurrence. They last longer, and they are very much less amenable to treatment. These attributes may not be dependent entirely upon the arteriocapillary fibrosis, they may be caused in part by the coincident disparagement of nutrition. From a therapeutic standpoint this group of cases has formed the most unsatisfactory of

all these cases. It has usually been recommended that the measures known to have a beneficial influence on arterial degeneration, such as potassium iodide or sodium iodide, be given in connection with nitroglycerin and nitrite of soda, and with small doses of digitalis. In truth, this treatment has not been attended with very brilliant results. Recently Dr. C. L. Dana, utilizing the suggestion of Dr. G. R. Elliott, has used large doses of strychnine hypodermatically, either into the tissues which are the seat of the pain or into other parts of the body, and at the same time putting the patient through a rest cure with all that it implies concerning regulation of diet and reinforcement of nutrition by the administration of food, iron, and arsenic. The iodine salts, and nitroglycerin if specially indicated, should also be administered. The beginning dose of nitrate of strychnine is from one-fortieth to one-sixtieth of a grain. This is increased daily, so that at the end of a week the patient is taking from one-eighth to one-fourth of a grain at each injection. The value of this mode of treatment is really great. I have had a number of cases yield to it when all other medicinal treatment had failed. The cases for its application must be selected, however, and the discipline of the rest cure must be carried out in all its details. At the present time, it seems to the writer advisable to recommend that the injections of strychnine be given combined with morphine, the latter in doses one-half of the amount of strychnine. The treatment must be kept up from six to twelve weeks. In the majority of cases it is by no means necessary to keep the patient in bed the entire time. Indeed, in some cases it may not be advisable to keep the patient in bed continuously for any of the time. It may only be necessary for him to lie down for an hour before and an hour between meals, while if the paroxysms of pain are not frequent and severe, the remaining hours of the day are spent in the open air.

The local treatment of trifacial neuralgia is by no means so important as the symptomatic and the constitutional treatment. The most important local measure is electricity. Unfortunately, enthusiastic, intemperate electrotherapeutics have come near to bringing this agency in the treatment of the tic douloureux into disrepute by advancing claims for its efficiency which could not be substantiated by the average practitioner who understood its use. It is an agency of comparatively small value in the treatment of trifacial neuralgia, yet the benefit that is sometimes derived from its use is sufficiently great to warrant giving it a conspicuous place, particularly when we recall that no one drug or physical agent is pre-eminently useful in this condition. Any form of electricity may be used, but it is generally agreed upon by neurologists that the galvanic current is more serviceable than the faradic, while static electricity is of no other service save in assisting to increase the patient's general nutrition and resistance. The mode of application of the gal-

vanic current is not all important. As a rule, the positive pole should be placed over the painful area and the negative pole on some indifferent place, such as the back or the sternum. The facial electrode may be a small one, or it may be large enough to cover the entire side of the face. In the first case, a current of from two to four milliamperes is allowed to flow for from five to ten minutes, the application being at first stabile and afterward labile. In the latter case a current of from one to two milliamperes should be allowed to pass for from one to several hours a day. Oftentimes the pain is greatly relieved by this plan of long-continued application of the current. Galvanism seems to be of greater service in the very acute cases which develop after refrigeration and the intoxications and infections than in the subacute and chronic forms. I have never seen much benefit from the use of the faradic brush nor from the application of the rapidly vibrating induced current. On the other hand, the administration of cocaine and aconitine by means of cataphoresis (see page 103) has proven very beneficial in some instances.

The next most important local application is heat. This is best applied by means of a closely matted coil of small rubber tubing, which, laid on the side of the head and face, closely adapts itself to it. A stream of water of a temperature of from 98° to 105° is allowed to flow through the tubing very slowly but constantly. One of the most obstinate cases that I have ever had under treatment was relieved by the utilization of this measure kept up for a number of weeks. The patient meanwhile was put through a rest cure and given small doses of iodide of potassium and tonics. The patient was a woman sixty-one years old in whom the symptoms were associated with marked trophic disturbances of the skin, hair, and soft tissues. She refused to receive injections of strychnine and morphine which was proposed, and this plan was tried as a substitute, fortunately with good results. Moist heat may also be used, but the difficulty attending its constant application militates against it.

It is difficult to estimate the worth of counter-irritation in trifacial neuralgia. Almost every substance that will irritate or inflame the skin, varying from the application of tincture of iodine up to the actual cautery, has been recommended and tried. At the present day they do not have a very conspicuous position in the therapy of this condition. Stimulating liniments and ointments are occasionally of some service in relieving the pain. The action depends in the case of the liniment upon the cooling of the skin, which is brought about by evaporation and by massage of the parts to which it is applied. The efficaciousness of the ointments, unless some active pain reliever, such as opium, belladonna, or cocaine, is a constituent of them, is dependent entirely upon the massage. Not that I mean to say that massage itself is of great value in the relief or cure of trifacial neuralgia. It does, however, act very efficiently in some instances, and especially in those cases in which

the trifacial neuralgia is developed upon a diathetic condition, such as rheumatism, gout, and slow degeneration of the blood-vessels. The mode of its application is by no means so important as the Swedish school of masseurs would have us believe. The following formula provides a liniment which can often be used advantageously in acute trifacial neuralgia:

℞ Camphoræ,
Chloral., ... ãã ʒi.
Mentholi, ... ℈i.
Sig. Rub on a few drops at a time.

Various forms of mechanical devices have been recommended in the treatment of trifacial neuralgia. Boudet has devised a method by which the vibrations of a tuning-fork, maintained by an electrical current, are applied directly to the nerve or its branches. A piece of wood about one centimetre in diameter attached to a tuning-fork in connection with the electrical current, is placed over the painful point. The incessant and rapid slight blows on this piece of wood induces, he contends, a local anæsthesia and is attended with marked soporific effect. Granville has likewise constructed a percussor which acts in a very similar way, and, according to the author and some other writers, with beneficial effect.

The Surgical Treatment of Tic douloureux.—Despite the great number of drugs that are recommended as serviceable in the treatment of this condition, and notwithstanding the many physical agencies that are employed for its relief, a considerable percentage of all the cases of severe trifacial neuralgia do not yield, at least with any degree of permanency, to any or all of these measures. This condition of affairs has created a demand for surgical interference. The advisability of performing any operation upon the trifacial nerve or the Gasserian ganglion has not yet been satisfactorily settled, notwithstanding the great number of operations that have been done and the strikingly beneficial results that have been reported to follow such operations. Many neurologists of large experience contend that the results of operation, be it neurotomy, neurectomy, neurexaresis, or partial or complete extirpation of the Gasserian ganglion, do not justify surgical interference save in exceptional instances. Surgeons, on the other hand, maintain that their statistics are such as to warrant them in undertaking any of these surgical procedures that may seem to be indicated in a given case. It should not be forgotten in estimating the factors for and against operation that trigeminal neuralgia is in the majority of cases a self-limiting disease, and if its intensity can be so modified by drug and mechanical therapy that the patient can withstand it, the disease will get better of itself. On the other hand, the sufferer's courage is often so weakened that he warmly accepts any procedure which gives him promise of relief,

even though it be a dangerous one, as extirpation of the Gasserian ganglion always is.

The first operation that was suggested for the relief of trifacial neuralgia was section of the temporal and occipital veins. Trousseau reported some cases that had been subjected to this treatment with apparently beneficial results, but his success seems to have tempted no imitators. Compression of the carotids and even ligature of them, was also applied in a number of cases and apparently with similar good results; but this also quickly fell into disrepute. Simple section of the painful branch of the trigeminal nerve was the next surgical procedure. This always succeeded in relieving the pain temporarily, but it invariably recurred, so that at the present time the operation of neurotomy is rarely undertaken. Neurectomy of the painful branch is the procedure that is unquestionably looked upon with most favor. Exposure of the painful nerve by operation and pulling it out from its surroundings so as to thoroughly stretch the fibres have likewise fallen somewhat into disrepute; although judging from the statistics this is the most useful available surgical procedure not attended with considerable danger. It should always be tried before recommending the patient to submit to extensive extra- or intracranial resection or extirpation of the ganglion. There can be no question that these severer operations should be undertaken in cases that are totally unamenable to all other forms of therapy.

The mortality attending complete extirpation of the Gasserian ganglion is less than twenty per cent, and although its removal is attended by many disagreeable shortcomings the relief from agony more than counterbalances them. One or all of the peripheral operations should always be done before the more radical one is thought of, even though the pain be of all the branches of the trigeminal nerve. But none of them should be advised until the possibility of cure by medication has been exhausted. If division of the peripheral nerves and thorough stretching fail to afford relief, nothing short of the radical procedure, namely, excision of the ganglion, should be considered. Operations for removing extracranial segments of the fifth nerve, such as Meckel's ganglion, and ligation of the carotid, are to be rejected.

There are many methods of performing the intracranial operation. The technique varies with the operator. The one most favored at present is the Hartley-Krause method. A horseshoe-shaped flap is made, the base of the flap being the zygoma. An osteoplastic flap is cut by chisels, the Gigli saw, or the surgical engine, and the base of the flap is broken by prying the bone outward. The dura is separated from the middle fossa. The third division of the nerve is found at the foramen ovale and the second division at the foramen rotundum. Each nerve is cut through above its foramen. The nerves are followed up to the ganglion, and the latter being then exposed is grasped with forceps and twisted out, and

during the twisting the sensory root will usually be brought out. The pressing danger is hemorrhage from the middle meningeal artery or from the veins on the floor of the skull. The operation is so hazardous that it should be undertaken only by most skilled and experienced surgeons. The entire ganglion should be removed. Immediately after operation the lids of the corresponding side should be stitched together, an opening being left at each canthus for drainage. At the end of about a week the stitches are removed and the eye is covered with a Buller's shield.

Treatment of the Attack.—The pain of trifacial neuralgia is of such character and intensity that it demands immediate relief in very many cases, and the only substance that can be relied upon to do this is morphine. As in all other conditions having a tendency to recur and to be chronic in their course, the administration of morphine should be avoided if possible, or at least delayed until other substances potentially less injurious have been tried. This statement should not be construed to mean, however, that the injection of morphine is not often immediately called for. In the beginning, especially of acute cases, one or two injections of morphine should be given and followed by the administration of antineuralgics that operate more slowly but with less certainty, such as aconitine, gelsemium, butyl chloral, and the analgesics of synthetic constitution. Aconitine, given in gr. $\frac{1}{200}$ doses, in the beginning every four hours, is frequently a potent measure in relieving the pain, providing it be carried to the point of full physiological action. It is a powerful poison and its effect should be watched very closely. If the neuralgic pain continues after the aconitine shows its effects by causing benumbing of the lips, tongue, and extremities, very little benefit is to be expected from its continued use. Fluid extract of gelsemium sempervirens, given in five-drop doses every three hours and increased until its full physiological action is obtained, is likewise of service in some cases. But if benefit does not seem to follow its administration after such poisonous effect as slight temporary motor paralysis occurs, its use should be abandoned. Aconite and gelsemium may be given together as in the following mixture:

℞ Tinct. aconiti, ... ℥ ss.
Tinct. gelsemii, ... ℥ iv.
Sig. Ten drops every half-hour till tingling is felt in the fingers.

The hydrate of croton chloral, called butyl chloral, is a drug that has been considerably recommended, given in doses of from two to three grains, combined with glycerin and with water. Its effects are by no means constant, and it is quite impossible to say whether or not it will be serviceable in any given case until trial of it has been made. It has the advantage of promoting sleep while relieving pain. The same results are to be obtained from giving bromidia, which is a

mixture of chloral hydrate, bromide of potassium, extract of cannabis indica, and hyoscyamus. But as each teaspoonful contains fifteen grains of chloral, it can readily be seen that this mixture should not be kept up for any considerable length of time.

The local injections that are most serviceable in relieving pain are a one-per-cent solution of osmic acid, either in water or glycerin; a two-per-cent solution of carbolic acid, in from one- to ten-drop doses; and a one- to five-per-cent solution of methylene blue in from three- to five-drop doses. Although osmic acid is a powerful escharotic, and even in this weak solution may cause tissue necrosis, it is nevertheless a substance whose administration has been attended with such excellent results that its use is recommended. The techñique of this method is as follows: The nerve, having been exposed at the spot indicated by as small an incision as possible, rarely more than half an inch in length, is hooked up so as to fix it. The freshly-prepared solution of osmic acid is then injected with an ordinary hypodermic needle, properly sterilized, directly into the substance of the nerve. The total amount injected should be from five to ten minims. Bennett, of London, in whose hands this method of treatment has been very successful, recommends that this amount should be introduced in two or three separate injections in order that the whole nerve may be as much as possible soaked in the solution. During the injections a pledget of sterilized gauze should be held firmly around the needle at the orifice of the wound in order to prevent the escape of the fluid externally. The effect of the solution upon the soft tissues is an immediate blackening. The wound unites by primary union.

All in all, the treatment of tic douloureux is a problem that should be approached with great determination, both on the part of the physician and on the part of the patient. The latter should try to eliminate impatience and despair, while the former should decide definitely upon a plan of treatment and carry it resolutely through to completion, whether it be to ignominous failure or to partial or complete success. He should studiously avoid therapeutic vacillation, giving one drug or mode of treatment to-day, and changing to another to-morrow because the first has not been of signal service. The physican should always keep before the patient the fact that the disease is in reality a self-limiting one in the majority of instances and that time may be confidently counted upon to bring with it relief. In the mean time, his life should be so arranged that injurious influences which precipitate an attack of neuralgia or keep it up after it has occurred will not be operative; while the general health and nutrition are maintained at the highest possible level.

CHAPTER XXIV.

THE TREATMENT OF NEURALGIA OF THE CERVICAL PLEXUS.

The two varieties of neuralgia in the domain of the cervical plexus that require individual mention are occipital neuralgia and cervico-brachial neuralgia. Occipital neuralgia, or neuralgia of the occipitalis major and minor and the great auricular nerves, is the most common form of neuralgia in the cephalic extremity. It is sometimes but not always associated with pain in the distribution of the superficial cervical, and the supraclavicular nerves. In my experience it is one and one-half times as frequent as trifacial neuralgia. The most common location of the pain is in the distribution of the great occipital nerve. The pain of occipital neuralgia may be continuous, but it is liable to paroxysmal outbursts. It is associated with more or less sensitiveness of the skin over the affected area, and occasionally with local and reflected vasomotor disturbances. It may radiate into the back or neck, and occasionally it invades one or more of the branches of the trigeminal nerve. The common causes of occipital neuralgia are exposure to cold and wet; direct trauma; local disease, such as of the cervical vertebræ, the cervical glands, and very rarely of the cervical blood-vessels; cervical pachymeningitis; and constitutional shortcomings, such as anæmia, intoxication, post-infectious states of the blood, and exhaustion, factors that are so common in all forms of neuralgia.

Treatment of Occipital Neuralgia.—Before attempting to treat occipital neuralgia it is important to distinguish it from the varieties of cephalalgia that are considered in the chapter on headache. The most important factors in making this differentiation are, the causes of the neuralgia and tender points in the distribution of the affected nerve. These tender points are of variable location, depending upon the branches of the cervical plexus that are the seat of pain. When the large occipital nerve is involved there is almost invariably a point tender to pressure, midway of a line connecting the mastoid process with the first cervical vertebra. Usually there is a second tender point between the anterior border of the trapezius and the posterior border of the sterno-cleido-mastoid muscle at the level of the second cervical vertebra. In every case of occipital neuralgia diligent search should be made for organic disease of the vertebræ, their environment and enclosure. Such search will occasionally be rewarded by the discovery of a beginning tuberculous osteitis amenable to proper orthopedic treatment. On the other hand, it may be the means of

detecting conditions such as enlarged glands, which act injuriously by their mere presence, and which can be removed. The pain of occipital neuralgia is rarely so intense that such examination is not feasible before any treatment whatsoever is begun. If it is, the examination should be made immediately after pain-subduing medicines have been given.

Cases of occipital neuralgia that are the result of exposure to cold and wet, the rheumatic diathesis, anæmia, and hæmotoxic conditions, are benefited by the application of dry heat and by the internal administration of the salicylates, antipyrin, phenalgin, and phenacetin on the one hand, and such blood restoratives as iron and quinine on the other. Occasionally this like other forms of neuralgia is of gouty origin, in which case some preparation of colchicum, and Epsom salts, should be administered. After the acute pain has been subdued, mild counter-irritation from application of mustard, small cantharidal blisters, or even the actual cautery, is of the greatest service. Galvanic electricity can be used with a considerable degree of assurance in occipital neuralgia of almost any causation. As in all other neuralgic conditions the anode should be placed over the tender points and glided over the course of the nerve and its branches, while the cathode connected with a large sponge is placed on some indifferent point. Care should be taken not to employ a current that will produce vertigo. A current of two or three milliamperes for three minutes once or twice a day is often followed by the most gratifying results. Occipital neuralgia which proves intractable and does not yield to causal, to pain-subduing, and to constitutional treatment should be referred to the surgeon, with a request that the offending nerve be laid bare in order that the cause of the neuralgia can be determined. If the results of such exploration be negative, the nerve should be resected, and if these heroic measures fail, the operation recently performed by Chipault and Demoulin of intradural resection of the posterior roots should be done as a last resort. This variety offers a wide field for the use of the measures that have been detailed under the caption of the general treatment of neuralgia.

Treatment of Cervico-brachial Neuralgia.—Neuralgic affections of the arm, aside from those resulting from accidental or purposeful injury, such as that inflicted by the surgeon, are uncommon, compared with like conditions in the lower extremity. The ulnar nerve, which gives cutaneous supply to the lower part of the forearm and to the inner part of the hand on its palmar and dorsal aspects, seems to be more liable to neuralgic pains than the median. The location of the ulnar nerve at the elbow is such that the nerve is easily injured by direct trauma or indirectly, as in fracture of the olecranon process. Moreover, the ulnar nerve is sometimes the seat of neuralgic pain in locomotor ataxia. Occasionally similar pain in the left upper extremity is associated with disease of the heart. Neuralgic pain associated with paræsthesia in the distribution of the ulnar nerve is not an uncommon occurrence in gouty subjects. The radial branch

of the musculo-spiral is often the seat of pain in brachial neuralgia. The character of the pain and its localization will depend upon the causation of the neuralgia and the nerves involved. The number and location of painful points will vary also in the same way.

In discussing the treatment of brachial neuralgia, the only special etiological factor that requires consideration apart from those mentioned under the general causation of neuralgia is that of occupation. Occupations and professions requiring exhausting use of the muscles of the different segments of the upper extremity sometimes cause neuralgia without other ancillary phenomena. It is often very important to recognize that the successful treatment of cervico-brachial neuralgia in such an individual depends almost wholly upon his giving up for a time such labor or professional work. Aside from these conditions neuralgia in the domain of the brachial plexus is associated with constitutional conditions, with direct and indirect injury, such as implication of the nerve in callus formation after fracture, with disease of the spinal column and its contents, such as pachymeningitis and syphilitic disease of the spinal roots, and with conditions that cause encroachment upon the nerves in the axillary and supraclavicular spaces, such as new growths and aneurisms.

When any of the causes of brachial neuralgia are amenable to surgical or orthopedic treatment, such treatment should be instituted. Such surgical measures as nerve stretching and nerve resecting should not be thought of until causal and restorative therapy have failed to give relief. In obstinate and resistant cases the operation of resection may be necessary. The removal of a segment of a pure sensory nerve, such as the radial, is not a very serious affair, and as it is likely to give relief from suffering for at least a long time, the procedure is wholly justifiable when medicinal measures fail. Constitutional abnormalities should be counteracted by giving iron, arsenic, strychnine, and quinine, and by the use of physical measures that can be relied upon to improve nutrition. Electricity, particularly the galvanic current, applied in the same way as in other neuralgias, is often a useful agency for the temporary and permanent relief of pain. The faradic brush is likewise of service in many cases. The pain can usually be relieved, for the time at least, by the application of rubefacients and vesicants, such as chloroform liniment, mustard, pieces of flannel wrung out of hot water and sprinkled lightly with turpentine or Cayenne pepper, cantharides, and the actual cautery. When the pain is not very severe, stimulating liniments are sometimes all that is required. Such combinations as the following will be found serviceable:

℞ Spiritus chloroformi, ... ʒ ij.
Menthol., ... ʒ vi.
Alcoholis, ... ℥ iij.

M. S. For external use. To be applied with a brush and covered with flannel, in order to prevent too rapid evaporation.

℞ Menthol.,
Guiacol., ... āā ʒ ss.
Alcohol. absoluti, ... ʒ x.
M. S. Apply locally as often as required. Cover the parts with cotton.

Complete rest to the part helps very materially to relieve the pain, and its good effects can be enhanced, especially at night, by the application of warmth or a prolonged warm bath. The customary analgesics and occasionally morphine must be used at some time in the treatment of nearly every case of any considerable severity.

Intercostal Neuralgia.

Neuralgic affection of the intercostal nerves, particularly of the anterior branches of the sixth, seventh, eighth, and ninth, is of comparatively frequent occurrence. The causes of intercostal neuralgia are the customary predisposing states in the blood, nutrition and vitality, such as anæmia, hysteria, infectious diseases, particularly syphilis and malaria, and cachectic conditions. The common exciting causes are exposure to cold, trauma, inflammation of adjacent structures, pressure of any kind, such as from disease of the coverings of the spinal cord, the spinal column itself, aneurisms or new growths, and reflex or radiating factors. For instance, intercostal neuralgia is sometimes associated with disease of the pelvic organs, and no direct connection can be established. On the other hand, intercostal neuralgia may be an accompaniment of cervio-brachial neuralgia. The intercostal nerves are surrounded at their origin by large venous plexuses, and are thus liable to manifest the sinister effects of sluggishness in venous circulation. Neuralgia of this causation is more liable to occur on the left side, as there is here greater obstacle to the emptying of these vessels. The pain of intercostal neuralgia is more or less continuous, but liable to paroxysmal exacerbations. It is often in more than one intercostal space, but rarely bilateral. Like all neuralgic pains, it is increased by jarring and forcible movements, and its presence is accompanied by easily detected tender points. These points are at the exit of the intercostal nerve from the intervertebral space, a point midway in its course at which the nerve becomes superficial; and at the termination of the nerve, usually at about the junction of the costal cartilage with the rib. The neuralgic pain may be preceded or accompanied by an eruption of herpes, whose distribution accurately maps the course of the nerve. Intercostal neuralgia accompanied with herpes is usually an extremely painful variety, and accompanied with marked hyperæsthesia all over the course of the nerve. The duration of an attack is from two to four weeks, and even longer. The physician should not promise complete relief in less time than this, for although occasionally well-directed therapy may cause

it to disappear in a few days, usually the associated conditions are not so readily overcome.

Treatment of Intercostal Neuralgia. — One of the most important factors in the treatment of intercostal neuralgia is rest in bed. It is not the rest alone, but the uniform warmth which contributes to the comfort of the patient. If the attack is not accompanied by herpes, the application of derivatives, such as mustard, a number of small blisters, or local hot packs, to which small quantities of turpentine may be added, or freezing the nerve by the application of a chloride of methyl spray, may be done. The chloride of methyl may be applied by saturating a long strip of cotton, which is then placed over the distribution of the nerve until the skin is slightly frozen. This oftentimes gives very prompt relief. Another measure that I have often used with considerable satisfaction, even in dispensary practice, is that of hot douches to the spine, followed by the application of dry heat over the course of the nerve. No other apparatus is needed save a pitcher and a tub. The water is poured from a height, and the beneficial effects depend both upon the temperature and the force. In the same way patients are often made comfortable by the full warm bath, given for a prolonged time and just before retiring. If the patient will not consent to remain quiet or in bed for a few days, it is advisable to strap the side firmly by means of adhesive plaster in a way very similar to that employed in fracture of one of the lower ribs. This will give a considerable degree of local rest, particularly if the adhesive bandages be applied firmly. In addition to the rest, it aids in maintaining warmth, and if rubefacients, such as capsicum, or a sedative like belladonna, be incorporated in the plaster, this treatment combined with internal causal treatment may be all that is required.

Galvanic electricity can always be relied upon to ameliorate the pain. It should be applied with the positive pole directly over the nerve, the anode on some indifferent part of the body, for from five to ten minutes each day, and twice a day if possible. A current of from two to four milliamperes is better than a stronger current. I have not had any considerable experience with faradic electricity in the treatment of intercostal neuralgia, but the majority of writers recommend the faradic brush if for any reason the galvanic current cannot be employed. Static electricity applied by means of the roller electrode directly to the nerve can be used advantageously for temporary relief of the pain. Massage is another physical measure that is often of much service. The necessity of determining and treating the cause of intercostal neuralgia is as incumbent here as in other varieties of neuralgic pain. When refrigeration or the rheumatic diathesis has an obvious connection with the neuralgia, the salicylates will be found to act almost like a specific. On the other hand, if the pain occurs with sclerosed blood-ves-

sels, in syphilitic individuals, or in the senile, the administration of iodide of potassium will be gratifying. Further enumeration of causal therapy would be superfluous. The necessity for overcoming constitutional shortcomings is very evident in view of the fact that intercostal neuralgia is particularly liable to occur in those who suffer from organic disease of some of the internal organs.

Rachialgia.

Pain in the back may be an expression of intercostal neuralgia and of lumbo-abdominal neuralgia, and as such it has already received some consideration. It may likewise be an accompaniment of a rheumatic condition in the muscles known as myalgia. As a rule, the majority of cases called lumbago by the patient are to be interpreted as varieties of myalgia. Spinal irritation, or that neurasthenic symptom complex to which this name was formerly given, is also attended with rachialgia and sensitiveness to pressure. But the term rachialgia is here used to indicate a neuralgic pain in the posterior spinal roots not associated with any of these conditions. It is to be looked upon as a form of articular neuralgia, analogous to that which is occasionally met in the articulations of other parts of the body. Occasionally a severe form of lumbago occurs with sprain of the sacro-vertebral articulation. It is characterized by severe pain which is increased by the slightest movement. Absolute rest is the most important factor in its treatment. The diagnosis of rachialgia is to be made only by a process of exclusion, and the indications for its treatment are purely symptomatic, it being understood that the general causal therapy of neuralgia is fulfilled. Careful investigation of rachialgia will result almost invariably in showing that the pain is dependent upon some of the conditions named above, and then the therapy will resolve itself into fighting these conditions. The measures that are to be taken for the relief of spinal irritation, myalgia, dorso-lumbar neuralgia, and symptomatic pain of disease in the spinal column, are considered elsewhere and therefore will not be referred to further in this connection.

Mammary Neuralgia (Mastodynia).

Mammary neuralgia occurs predominantly in females, although males are sometimes affected. I have seen two cases in the latter sex. In one of these it was undoubtedly the result of the pendulousness of enormously hypertrophied mammary glands which hung down over the upper part of the abdomen. The second patient suffered from chronic parenchymatous nephritis. Mammary neuralgia is immediately dependent upon a perversion of function in the descending branches of the supraclavicular nerve, but especially of the pectoral cutaneous nerves coming from the second,

third, fourth, and fifth dorsal nerves. The direct causes cannot always be elicited, but in many cases the relationship of lactation, pregnancy, disease of the uterus, sexual excitement, and trauma, such as from a blow or a badly fitting corset, can be made out. It is often seen in anæmic, hysterical women, and particularly those who have seen members of their family or friends afflicted with inflammatory or malignant disease of the breast. The psychical element in mastodynia plays a more conspicuous rôle than in any other form of neuralgia. Occasionally it occurs with the growth of small fibromata or neuromata in the breast.

Treatment.—The first thing to do in the treatment is to remove the cause and give complete support to the breast. If the latter is physiologically or pathologically enlarged and pendulous, strapping or slinging it is often sufficient to relieve the pain, particularly if some soothing application, such as a liniment containing belladonna, be applied at the same time. If it occurs during lactation and is not susceptible to such simple measures for relief, it may be advisable to give medicines that are known to have a tendency to check the secretion of milk, and to apply an ointment containing atropine. After what has been said as to the constitutional conditions with which it is often associated, no specific directions are called for to show the advisability of treating the anæmic, hysterical states of many of these cases. The following ferruginous tonic is oftentimes very beneficial as a constitutional measure:

℞ Quinin. sulphatis,
Ferri pyrophosph., ... ää ʒ i.
Acid. phosph. dil., ... ℥ i.
Aquæ, ... ℥ iij.
M. S. Teaspoonful three times a day.

Electricity and massage may be used with promise of service in almost every case in which there are no evidences of organic disease, particularly in those occurring apart from the puerperium. Very rarely is it necessary to give the analgesics, except in cases which are dependent upon exposure to cold and those occurring with rheumatism. Instances have been recorded in which the pain was so severe that amputation of the breast was necessary. Unfortunately, the heroic measures instituted for the relief of the neuralgia failed to give the desired effect, as in these cases it is the general neurotic state, which is being expressed as a mastodynia.

CHAPTER XXV.

THE TREATMENT OF NEURALGIA OF THE LUMBAR PLEXUS.

The branches of the lumbar plexus of nerves are not the seat of true neuralgia so frequently as those of the sacral and coccygeal. It is rarely, if ever, the cause of rachialgia, or pain in the back, for as has previously been shown, when this complaint is not dependent upon muscular weakness, it is almost invariably an expression of neuralgia in the domain of the lower dorsal or intercostal nerves.

Neuralgia in the domain of the lumbar plexus may be conveniently considered under the five following captions: 1. Lumbo-abdominal neuralgia, to include painful condition in the distribution of the upper branches of the lumbar plexus, that is, the ilio-hypogastric and the ilio-inguinal nerves. 2. Testicular neuralgia, or irritable testicle, which is oftentimes a manifestation of the pain in the genito-crural nerve, but which is nevertheless quite as often an affair of the sympathetic system of nerves, and especially those branches having their distribution in the spermatic plexus. 3. Femoral or crural neuralgia, an uncommon variety, attended by pain in the domain of the middle and internal cutaneous branches of the anterior crural nerve. 4. Neuralgia of the external cutaneous nerve, a condition that has been given individual recognition and description only during the last few years. And 5. Obturator neuralgia.

Although brief individual mention will be made of each variety, it will readily be understood that the causative factors and the leading indications for treatment in one variety are much the same as in the others.

Lumbo-Abdominal Neuralgia.—The pain of lumbo-abdominal neuralgia is confined to the cutaneous distribution of those nerves which embrace the lower part of the lumbar region, a part of the hips, and over the inguinal region. The common attributive causes are exposure to cold, rheumatism, strain, and direct injury. Like all neuralgias, it is of more frequent occurrence in those whose constitution is depraved from excesses or diseases. Occasionally it is a symptom of disease in or around the spinal column. The pain of lumbo-abdominal neuralgia is of variable location, depending upon the branch of the ilio-hypogastric or the ilio-inguinal nerve that is affected. Usually it is of a dull character, more or less continuous but liable to paroxysmal exacerbation, situated in the loin and radiating toward the iliac crest, the groin, and the lower part of the abdomen. It may occur simultaneously with pain in the genito-crural nerve and then be accompanied by symptoms which are considered diagnostic of this form of neuralgia. The nerve branch that is the seat of pain

sensitive to deep-seated pressure, especially at the point at which it approaches the surface. Occasionally, it is associated with neuralgic pain manifest through the lower intercostal nerve and sometimes also in the lower branches of the lumbar plexus.

Testicular Neuralgia.—Genuine neuralgia of the testicles may be manifest in nerve fibres originating from the lumbar plexus, from the sacral plexus, or from the spermatic plexus of the sympathetic. Except in minor degrees it is a comparatively rare ailment. In addition to the etiological factors that have been enumerated as causative of lumbo-abdominal neuralgia, sexual excesses and varicocele are the attributed causes. Some writers seem to think that prolonged continence is a predisposing cause, but this cannot be substantiated. Irritable testicle, which is a variety of testicular neuralgia, is of somewhat common occurrence in young men of neurotic disposition. Occasionally it is an entailment of senility. Although it is met apart from the neuroses, such as neurasthenia and hysteria, the determining factors in such cases are usually apparent, and are, exposure to cold, and trauma. The pain is almost invariably unilateral, and is of a peculiar dragging, sickening character, lessened by supporting the scrotal contents and by keeping them in a position of complete rest. It is exacerbated by pressure and by movement, such as coughing, sneezing, standing, and walking. Oftentimes the pain is so severe that it causes nausea, great prostration, and firm retraction of the testicle. If it is of long duration, it is very apt to produce a state of mental depression and of physical listlessness, which require to be combated in the successful treatment of this condition. Its occurrence demands a close investigation of the scrotal contents, of the condition of the general health, and of the state of the spinal column and the spinal cord. Very rarely it occurs as an early symptom of tabes dorsalis.

The most important element in the treatment, by all means, is the causal treatment. If the cause be discovered and removed, and if constitutional conditions predisposing toward neuralgia be overcome, usually all that is necessary is to support the testicle by means of a suspensory. This variety of lumbar neuralgia requires the adoption of measures for prompt relief of the pain more insistently than does any other. The same danger exists in the use of morphine, particularly its hypodermatic use, as in other forms of intractable or recurring pain. Despite this, it is sometimes incumbent upon the physician to use it. If the pain is of only moderate intensity, efforts may be made to overcome it by means of dry heat, by applying an ointment that simultaneously reddens the skin and blunts the conductivity of the sensory nerves, such as one containing cantharides and belladonna. Dry heat is another measure that may be used with satisfactory results. The galvanic current, occasionally serviceable in relieving lumbo-abdominal neuralgia, is not to be applied in neuralgia of the testicle. Very rarely is the pain of such severity and

intractability that castration is demanded. Although the patient may interpose no objections to such apparently heroic treatment, the physician should not forget that in many instances in which this operation has been done for the relief of neuralgia the pain has continued or recurred after the testicle was removed. Castration should always be delayed as long as possible, and such operations as ligation of the spermatic veins, if there be any evidences of varicocele, done first. The constitutional treatment, such as regulation of the bowels, the adoption of measures that increase physical strength, such as hydrotherapy, massage, and gymnastics, and the administration of such restoratives as iron, arsenic, quinine, are of greater importance than any other treatment save that which looks to overcoming the pain.

Meralgia Paræsthetica.—Neuralgia in the distribution of the external cutaneous nerve of the thigh would seem to be a commoner affection than has hitherto been supposed. It is sometimes called meralgia paræsthetica, a name given to it by Roth of Moscow, who was one of the first to call attention to this condition as an individual occurrence. As the name implies, the symptoms of the affection embrace paræsthesia, usually of a somewhat indefinite character, as well as pain, in the territorial distribution of this nerve. A noteworthy feature of this form of neuralgia is that it disappears when the patient is reclining or sitting, and that it returns when he puts the extremity to any considerable use in standing and walking. The pain is located in the outer and posterior surface of the thigh, reaching from the crest of the ilium to the knee, but often only a small portion of this surface is implicated. The most common painful pressure-point is over the trunk of the nerve, just below the anterior spine of the ilium, where it divides into an anterior and a posterior branch. The attributed causes of meralgia paræsthetica are direct injury, which may antedate the occurrence of the pain for some time; fatigue of the lower extremities, induced particularly by prolonged standing and walking; pressure, such as from abdominal bands, tight trousers, and stocking suspenders; exposure to cold and wet; and the other common causes of neuralgia, such as the intoxications and infections. Very rarely have enlarged inguinal glands and dilated veins of the lower extremities been looked upon as causes. In Germany it seems to have a special inclination to afflict physicians, judging from the reports of those who have described their individual sufferings. Apparently it is not a difficult form of neuralgia to overcome. The treatment which has been found very satisfactory consists, after removal of the cause, of the use of warm full baths and of application of dry or moist heat to the affected part; of massage, which may be used in connection with soothing ointments, such as one containing belladonna; the use of galvanic electricity, the positive pole over the seat of the pain, or of the faradic brush; of prolonged rest when this is possible, and of the administration of tissue reconstructives.

Femoral and Obturator Neuralgia.—The remaining two varieties of lumbar neuralgia, that is, neuralgia in the domain of the femoral and obturator nerves, are relatively of rare occurrence. In femoral neuralgia the pain occurs in the area of distribution of the middle and internal cutaneous nerve, extending to the skin upon the fore part and inner side of the thigh. Very rarely is the cutaneous nerve which is distributed to the inner side of the legs and foot the seat of pain. The causes of neuralgia in this nerve are the same as the causes of sciatica, or of neuralgia in any other branch of this plexus. Obturator neuralgia is still more uncommon. It is doubtful that it occurs with any other condition save that of obturator hernia. Pain in this nerve is probably in reality through the plexus which is formed by sensory branches. These anastomose with the internal cutaneous branch of the anterior crural nerve and a branch of the internal saphenous. Cases have been described in which the neuralgia was attributed to compression of the nerve within the pelvis by pelvic exudates and during childbirth, but it is somewhat doubtful whether these conditions were more than indirectly responsible for the occurrence of the neuralgia. Both femoral and obturator neuralgia require the same careful search for their cause that sciatica does, and after its removal practically the same treatment as that outlined for sciatica.

Leg Pains with Varicose Veins.

Pain in the legs resembling sciatica or crural neuralgia is sometimes associated with superficial or deep varicose veins. Although pain of this origin has usually some features sufficiently distinct to indicate its proper interpretation, it is often confounded with sciatica because the commonest locations of the pain are in the calf of the leg and the ball of the foot. In the latter location the distribution of the pain may be quite analogous to that of sciatica. The immediate cause of this form of pain is, as has been said, structural disease in the walls of the veins. The remote causes are included in the etiology of varicose veins. The pain which accompanies this condition is usually diffuse, the patient rarely localizing it to the distribution of one nerve. It is worse toward evening, and is exacerbated by any condition that interferes with the return of circulation. On the other hand it is lessened by rest, by raising the feet, and by gentle massage, the rubbing being directed toward the body, thus facilitating the blood return in the veins. The treatment of this condition is palliative or radical, directed toward the diseased blood-vessels; in other words, the treatment is that for varicose veins. This may be so simple as taking appropriate active and passive exercise, the wearing of an elastic support to the cutaneous veins, or multiple ligation. It should not be forgotten that constitutional states must be reckoned with in order to bring about complete cure of the dilated veins.

CHAPTER XXVI.

THE TREATMENT OF SCIATICA.

Sciatica is the name given to pain in the distribution of the sciatic nerve. Like all nerve pains, it may be dependent upon a number of different conditions. The fact that these conditions are not carefully differentiated accounts in a measure for the very unsatisfactory status of the treatment of sciatica. In the chapter on trifacial neuralgia I have drawn attention to the fact that a number of different affections of the nerve, either functional or organic, have been included by writers under the head of tic douloureux, and also that it was not until these conditions were differentiated that satisfactory results attended their treatment. A similar statement holds good for sciatica. In brief, then, the term sciatica should not be used in any other sense than to signify pain in the sciatic nerve and its territorial distribution. The systematic writer, however, finds it difficult to maintain this position, largely because the term has been used collectively to include all the functional and organic diseases of the sciatic nerve. I shall endeavor to differentiate the painful affections of the sciatic nerve, at least in so far as the therapeutic indications are concerned. It is, unfortunately, almost impossible to discriminate between sciatica due to a mild degree of inflammation in the perineural structures and in the nerve itself, and sciatica which is the result of dynamic or functional disorder of the nerve. Naturally, when inflammation or degeneration of the nerve is accompanied by such conditions as marked tenderness on deep-seated pressure over the nerve trunk, atrophy of individual muscles or groups of muscles supplied by the nerve, pronounced sensory disturbances, changes in the electrical reactions of the neuromuscular apparatus, and perversions of the tendon jerks, one can say quite positively that the nerve is organically diseased. But in many cases the inflammation or degeneration is so slight and the process of repair so active that these phenomena are not present and elicitable. Moreover, the factors that are operative to produce inflammation or degeneration of the nerve are the same as those that cause functional disorder of the nerve accompanied by pain. This adds greatly to the difficulty of saying where functional disorder of the sciatic nerve ends and where organic affection begins. Despite this difficulty, however, the successful therapeutist is he whose clinical insight and expenditure of time and care lead him successfully to approximate this differentiation, and who is guided in his selection of remedial agencies by the informa-

tion thus obtained. It is of comparatively little service to enumerate the different drugs or applications and appliances that have been used successfully in the treatment of sciatica; indeed many doubt that it is of any service at all. That which is of signal benefit in one affection characterized by pain in the domain of the sciatic nerve is useless and may be injurious in another; so that nothing is contributed to the therapy of this condition by citing one case or even a number of cases that have yielded to the administration of nitroglycerin or to the application of the actual cautery to the ear. The incumbency is to specify the form or variety of disease upon which the sciatica that has yielded to such therapy is dependent.

Etiology of Sciatic Pain.—Painful affection of the sciatic nerve occurs much more frequently in men than in women, and the relativity is subject to great variations depending upon climatic conditions, occupation, mode of life, and liability to injury. According to the statistics of some writers the proportion is as great as five to one, while according to others men are affected only one and one-half times as frequently as women. My own statistics show that sixty-five per cent of the cases are of the male sex. It will at once be seen that this predilection of sciatic pain for males is in conformity with that of neuralgic affections in general which are more common in males. Sciatica is more apt to occur in men whose occupation predisposes to injury, to overexertion, and to exposure. The sciatic nerve seems to be more or less immune to most injurious conditions until the age of puberty. From that time until the thirtieth year it is rarely affected in such a way as to cause pain. From thirty to sixty, and particularly from forty to fifty, it is especially liable to be diseased functionally or organically, to a degree that causes pain. More cases of sciatica of all kinds are seen during the winter and spring than during the other seasons, particularly if the weather be inclement and severe. Occupations that necessitate exposure to wet and cold, particularly after physical effort, and those that call for prolonged use of the legs without sufficient rest, are very potent factors in causing sciatica.

The purely neuralgic forms of sciatica are oftentimes in close and discernible relationship to such diatheses as rheumatism, gout, autointoxication, and the fibroid diathesis; also to conditions that are attended by dissociation and disorganization of the components of the blood, such as the various forms of anæmia and the conditions upon which they are dependent, whether they be those which prevent the formation of the constituents of the blood or those which facilitate and cause their destruction. Sciatica of this form occurs with pregnancy and lactation, diabetes, and various forms of poisoning in which the toxic coefficient is not intense enough to cause disorganization in the nerve itself. It should not, however, be forgotten that often these

same factors are sufficiently intense to cause true disease of the nerve, which is attended by sciatic pains; for instance, alcoholism; infectious diseases, such as grippe, pneumonia, typhoid fever, malaria, and septic infection; poisoning by lead, arsenic, and tobacco, may cause sciatica which is not dependent upon organic affection of the perineurium of the nerve or of the nerve itself. But if they act with sufficient intensity and duration they may cause such affection. Of the traumatic conditions that cause sciatica, the most important are exposure to cold, either directly, as by a draught on the naked hips while sitting in a closet, or indirectly, through the clothing.

The next most common form of trauma is from direct blows or falls on the buttocks and back of the thigh, which may or may not be attended with surgical conditions, such as fracture of the thigh or pelvic bone. A very much rarer variety of trauma is from punctured wounds. Many intrapelvic conditions give rise to sciatica. These may be so simple and amenable to treatment as impaction of fæces, chronic constipation, displacement of the uterus, or a variety of simple intrapelvic inflammation, or they may be so severe as malignant disease arising from the pelvis or its viscera. Pain in the domain of both sciatic nerves may be caused by interspinal growth, pressing upon the roots of the spinal nerves and cauda equina from which the sacral plexus takes its origin. The most common variety of such intraspinal neoplasm is unquestionably gumma. Finally, the sciatic plexus and its continuation, the great sciatic nerve, may be themselves the seat of new growths, which cause sciatica. Hysterical sciatica is an uncommon affection, in this country at least, but the report of carefully studied cases, principally from France, which have yielded to suggestion shows that its occurrence is a reality.

Symptoms.—The symptoms of sciatica are by no means constant. As will be readily inferred after the remarks anent its causation, the clinical picture is subject to profound degrees of shading and coloration, varying with the cause, the individual affected, and the pathological dependency of the pain. The distinctive feature is pain in the course of the sciatic nerve or some segment of it. In one case the pain will be confined to the hip, in another to the calf, and in a third to the ball of the foot. Usually, however, before the termination of the sciatica, the patient will experience pain throughout the entire nerve. The pain is sometimes preceded and more often accompanied by more or less paræsthesia, itching, crawling sensation, tingling, or a feeling of numbness. The pain is of variable severity and its character may be boring, burning, lancinating, or a dull, heavy, nauseating ache. It is almost always worse at night, and especially during the hours when the general vital resistance seems to be lowered—between midnight and early morning. The pain is increased by movement of the extremity, by attempts to stand and walk,

and by anything that tends to increase venous pressure and at the same time jar the body, such as coughing, sneezing, and straining at stool. It not infrequently radiates into other nerves, being thus accompanied by pain in the domain of the lumbo-sacral nerves, and occasionally in nerves of other parts of the body. There are few constitutional symptoms aside from those conditioned by the disease of which the sciatica is a complication, unless the sciatica is dependent upon neuritis. These symptoms, however, may be very prominent, and their interpretation is of the greatest service in orienting one as to the proper treatment.

On examination the sciatic nerve will almost invariably be found sensitive to deep-seated pressure, and especially where it can be pressed against a bony surface or where it becomes superficial. The four points at which pressure usually causes pain are at its exit from the sacro-sciatic notch between the trochanter and the tuberosity of the ischium; at the inferior border of the gluteus muscle; in the middle of the thigh, just above a point at which the nerve usually divides; and finally, in the middle of the calf. Occasionally, the entire posterior surface of the thigh and leg is sensitive to any considerable pressure and manipulation. If the pain is due to neuritis, perineuritis, or to adhesions of the nerve sheaths pain on pressure will be very great. The patient usually keeps the affected lower extremity in a moderate state of flexion at all the large joints. If the knee be held extended and the lower extremity forcibly flexed on the pelvis, he will complain of an intense burning, shooting pain along the entire course of the nerve. When the patient stands or walks the semi-flexed condition of the lower extremity gives him a somewhat characteristic attitude and gait, which together with the compensatory curvature of the spinal column that results if the sciatica be of long duration has been much studied and described. Sciatic scoliosis is purely a static affair and its extent and intensity depend upon the degree and duration of the sciatica. When the sciatica is dependent upon organic lesion of the nerve, which is the result of injury or pressure from without, or from interstitial changes, the accompanying symptoms will depend upon the degree and intensity of the destruction of nerve tissue. There will be variable degrees of muscular atrophy, changes in electrical excitability, alteration of the tendon jerks, sensory disturbances, cramp in the muscles supplied by the diseased nerves, contractures, and other manifestations of neuritis.

The duration of an attack of sciatica is very variable. It stands more closely in relation to the cause of the attack than to anything else. An acute attack of sciatica dependent upon refrigeration, or a manifestation of the rheumatic diathesis, may last only a few weeks. On the other hand, another attack which apparently has the same causation may last several months, during which time there may be more or less complete remission in the severity of the symptoms. The duration of the attack

depends very largely also upon the treatment adopted. If the attempt is made to treat the patient while he continues at his work or while he is allowed to go about as usual, it is safe to prophesy that weeks and months will elapse before he is thoroughly rid of pain. When the condition is entirely cured, however, the tendency to relapse is not so great as is ordinarily supposed.

Treatment.—Before treatment is begun it is absolutely necessary to decide whether the sciatica is idiopathic or whether it is secondary to some other disease. It is also very desirable to estimate as closely as possible the pathological diagnosis. Sufficient has already been said concerning the necessity of individualistic treatment when confronted with a patient suffering with sciatica. It must be impressed upon the reader that sciatica is one of the conditions in the treatment of which he cannot be guided exclusively either by precedent or by experience. Injections of carbolic acid or osmic acid may be just the treatment required for one case, while in the next case their use would mean great injury to the patient. The physician who treats sciatica in a routine way according to a plan that he has found successful in some cases or according to instructions which he has got from a text-book, is foreordained to a larger percentage of failure than he who makes the most searching investigation to find the cause of the sciatica and the condition of which it is an expression, although he follows a more or less inflexible plan of treatment.

Treatment of Recent Cases.—The general plan which should be adopted in the treatment of recent and acute cases of sciatica may be said to be about as follows: The first and most insistent necessity is that the patient shall go to bed and stay there until the acute pain has subsided. Absolute rest is by all means the most important element in the treatment of acute sciatica, and the physician who compromises with the patient on this point is the one most likely to fail in effecting a rapid and complete recovery. It is not sufficient that the patient remain within doors and be allowed to get about the house or lie on a lounge, and to go to the closet in response to the calls of nature. Rest should be absolute and in bed. Moreover, the continual application of either heat or cold, which is nearly as important as rest, can be effected in no other way than by keeping the patient in bed. Attention to the details of mattress and coverings will be rewarded by a gratifying degree of comfort to the patient. They should be of such a nature that no irregular pressure will be made upon the posterior surface of the lower extremity, and that the bodily heat be prevented from dissipating. The patient soon learns that the pain is less intense when the knee is partially flexed, and this position should be maintained by pillows or by sand-bags if it be decided to use dry heat instead of cold as a sedative and antiphlogistic agency. A most important decision which the physician has to make is whether to use heat or cold. The advocates of the first are quite as confident of its superior

efficacy as are those of the second. As a matter of fact the determining factors should be the idiosyncrasies of the patient and the dependency of the pain. An anæmic, run-down, irritable, nervous woman, who dreads the very thought of cold, will be very likely to look forward to an application of dry heat with more pleasure and confidence than she will to ice-bags or cold, wet applications. Nevertheless, if the ancillary phenomena and findings seem to indicate that the sciatica is an expression of an inflammatory state in the nerve itself or in its coverings, the feelings of the patient should not be allowed to stand in the way of the application of cold, either in the shape of chloride of methyl spray or ice-bags from the exit of the sciatic nerve to its plantar distribution. There seems to be a very nearly unanimous belief on the part of those who have had experience that this measure far outranks any other in ameliorating the pain. The ice must be applied continuously for several days, even weeks, and it should be discarded only when cessation of the pain shows that the inflammatory condition has nearly if not quite subsided. When the pain is limited to one section of the extremity, such as the gluteal region or the thigh, it is of course not necessary to apply cold to the entire extremity. On the other hand, if it is found that the application of cold may be necessary for a considerable time, it can be applied by a simple apparatus constructed from rubber tubing, through which a stream of ice water is allowed to flow slowly.

The plan proposed by Dr. Weir Mitchell, of Philadelphia, of bandaging the extremity with a thin all flannel bandage reaching from the foot to the groin, may be used in connection with the application of continuous cold. The bandage by causing gentle, firm, evenly distributed pressure lessens the amount of blood circulating in the leg, and acts as an important accessory to the antiphlogistic pain-benumbing qualities of the continuous cold. Cases in which there are no evidences that the sciatica is dependent upon inflammation of the nerve or its sheath, and in which there are no special indications which call for the use of cold, are best treated by the application of dry heat. This may be applied by the hot fomentation compress or by hot-water bottles; but one of the most satisfactory methods is by the use of sand encased in long flannel bags. After being heated in an oven they retain their heat for several hours. The leg is bandaged in flannel, as described above, surrounded with layers of cotton or wool, so as to prevent the sand-bags from pressing directly upon it; then the sand-bags, which have been previously heated, are put along each side of the extremity which they maintain in whatever position is found most comfortable for the patient. I have used this measure as an adjunct in the treatment of sciatica for many years with gratifying success. It is particularly useful in sciatica caused by refrigeration and accompanying the rheumatic diathesis and impoverishment of the blood. The hot fomen-

tation compress is a most serviceable agent in the treatment of acute sciatica. It often gives speedy and gratifying relief. Much depends upon its careful and proper application. Pieces of woollen blanket or flannel, two feet square, are soaked with hot water and then passed through a clothes wringer when they are ready for application. The part to which they are applied must be thoroughly covered with some oily substance to prevent formation of blisters. The cloths are removed every twenty minutes. Their application soon causes perspiration, which may be enhanced by wrapping the patient in blankets. They should be kept up for about two hours and repeated twice in the twenty-four hours. After each application the patient should be washed off with water of 75° F. and a moderate degree of dry heat applied to the leg.

In many cases of acute sciatica it is unnecessary to employ either heat or cold in the way described above or in any other way. All that is necessary after putting the patient to bed may be counter-irritation by means of the actual cautery applied over the course of the nerve by instantaneous touches from its exit to the lowest level at which pain is present. This is followed by appropriate dressing, bandaging, and immobilization of the extremity, or by the use of large mustard and flaxseed poultices until the skin is thoroughly counter-irritated. These, with the appropriate internal treatment, will be found efficacious in many cases of moderate severity. Naturally it is understood that they may be repeated if necessary. Occasionally, the application of dry cups over the course of the sciatic nerve, particularly at the sciatic notch, and over the seat of intensest pain, is followed by relief. If the patient is a man of plethoric disposition, the extraction of blood by leeches or by wet cups is extremely salutary, not alone in relieving the pain at the time, but in influencing its permanent disappearance.

In addition to these measures careful attention should be given to the patient's diet and to the state of the alimentary canal. The effects of a prompt and vigorous cathartic, and the adoption of a light and easily digested diet, principally of milk, not a low diet necessarily, are often very striking. The necessity of overcoming constipation, especially in women and in men of sedentary habits, is very great. Many a patient has recovered after prolonged medication when placed upon a course of Carlsbad salts. It is unnecessary to add that stimulants are to be avoided. Before utilizing any of these measures, however, it is necessary to relieve pain, and in the beginning, if the pain is of such severity that it prevents the patient from obtaining a requisite amount of sleep and exhausts his nervous energy, a full dose of morphine should be given, both for its moral and its physical effects. After that reliance can safely be placed upon the less injurious pain relievers, such as antipyrin, phenacetin, and the salicylates. In cases which have apparently been caused by refrigeration and in those occurring with manifestations of the rheumatic state, the

salts of salicylic acid, particularly those of sodium and potassium, should be given in full doses. Especially should a large dose be given at bedtime, and if there be especial indication, it may be given simultaneously with one of the milder hypnotics. Every case in which there is a history of gout or demonstrable evidence of its existence calls for the determined use of colchicum, and strict attention to the diet. The use of aconitine and of gelsemium to benumb sciatic pains is according to many a questionable procedure. They have been highly recommended by some writers, but they have lost caste, particularly since the introduction of the modern analgesics.

The indications for causal therapy should be vigorously sought in the recent as well as in the ancient case of sciatica. If it can be shown that any of the conditions which have previously been mentioned as causative of sciatica are operative, such as syphilis, malaria, poisoning from lead or arsenic, diabetes, autointoxication, or impaction of fæces, specific medication should be directed toward fighting it as soon as the general indications for treatment above mentioned have been fulfilled.

The causal treatment should be supplemented by earnest administration of dietetic and medicinal reconstructives. It seems unnecessary to enumerate these in detail here, as they have already been often considered. Furthermore, those medicines which act as reconstructives in one individual have no such effect in another. The alert practitioner will not need explicit directions when to give iron, arsenic, cod-liver oil, and phosphorus, no more will he neglect to give one or all of them if direct indications for their use exist. Although sciatica often occurs in apparently healthy persons, that is, in those who do not stand in need of reconstructive treatment, the suffering and sleeplessness usually entail perversion of the general nutrition. This in turn tends to prolong the duration of the sciatica unless it is combated. Sleeplessness itself oftentimes requires the adoption of measures directed immediately against it. Usually the pain relievers are sufficient to overcome it, but when they fail, no hesitation should be had in giving such hypnotics as trional, sulfonal, and paraldehyde, providing there be no direct contraindications to their use. It is usually not necessary to continue giving them long, nor should any one of them be repeated more than a few times.

Treatment of Subacute and Chronic Sciatica.

The mode of treatment and the above enumerated measures suffice for the majority of sufferers with acute sciatica, whether the sciatica be dependent upon true neuralgia or slight perineuritis. This being true, it is astonishing that so many cases of this affection go on to a chronic state. That they do is beyond question, and it is due mainly to haphazard treatment and to compromising with the patient regarding the plan of treat-

ment. Some cases, however, are subacute or chronic in their clinical manifestations, even from the beginning. Sciatica manifesting itself in a subacute or chronic fashion requires somewhat different treatment from the acute variety. Although the methods of treatment of both forms have much in common, it is in the latter especially that counter-irritation, electricity, massage, gymnastics, hydrotherapy, balneotherapy, nerve stretching, acupuncture, suspension, etc., in short, what may be termed the physical treatment, are of the greatest service. Each one of these measures has its advocates now, as it has had in the past. The impartial reader might infer from perusal of the lavish eulogiums of these advocates anent the serviceability of their pet remedy that all others were unnecessary save the one under consideration. For instance, one physician reports an enormous percentage of cures from the use of electricity; another has had equally good results from acupuncture, while a third, the balneotherapist, contends that chronic sciatica yields more uniformly to the procedures applied at the particular thermal spring at which he is resident than almost any other symptom or disease which he encounters. The truth of the matter is that chronic sciatica will yield to almost any plan of treatment that has for its purpose the improvement of the local and general nutrition, if it is combined with causal treatment, regulation of the bowels, and the general dietetic and disciplinary entailments of a well-formulated plan of treatment.

The Treatment of Chronic Sciatica.—One of the most important things to determine early in the treatment of chronic sciatica is whether or not the patient should have rest. As a general rule, if there are no indications of organic involvement of the nerve, activity is much more serviceable than rest. The movements that may be advised are active and passive, the latter being by far the more important. They may be utilized in the shape of massage and resistance exercises. Massage has the virtue of improving both the local and the general nutrition. Applied directly to the parts that are the seat of pain, it causes a determination of blood thereto and promotes active metamorphosis, which is an important factor in assisting the nerve to regain its normal condition. In the same way it tends to prevent inactivity atrophy or to overcome it if it already exists. It is very necessary to tell the patient that massage must be done thoroughly and kept up for a considerable time before beneficial effects will be seen. Moreover, it should not be relied upon as the sole therapeutic agency. The manner of its administration is not so important as many exponents of the art would have us believe. The patient, lying on the belly, should have the entire extremity from the sole to the ilium gently rubbed and kneaded, beginning from above and gradually working downward to the ball of the foot. If the nerve or its main branches are particularly sensitive to pressure, the massage should at first be very gently and not of prolonged application, never for more

than from ten to fifteen minutes; for often the patients, especially men, become irritable, sleepless, and filled with unrest, if the attempt is made to force it. At each succeeding séance it should be applied more vigorously, so that eventually the friction, stroking, and pressure operate directly upon the nerve trunk and its branches. At the end of each application the patient may profitably be put through a series of resistance movements which bring into activity not only the muscles supplied by the sciatic nerve, but their physiological antagonists. If it is found that these movements have a tendency to increase the pain, they should be dispensed with, while an effort is made to obtain similar results by having the patient walk, stand on the toes, bend over and touch the floor without flexing the knees, etc. If there be deformity of the trunk as the result of prolonged incapacity of the affected extremities, suitable calisthenics to overcome this should be instituted in conjunction with massage and resistance exercises.

Electricity in the Treatment of Chronic Sciatica.—Electricity may be used simultaneously with massage to advantage. By far the most important form of electricity is galvanism. Like all other therapeutic agencies, it must be used methodically and persistently. Disappointment will follow almost invariably if the attempt be made to use it otherwise. The patient should be treated lying down, a large sponge electrode connected with the negative pole applied over the small of the back at the sacro-iliac junction. The positive electrode, one-third or one-fourth the size of the negative, is placed immediately below it and a current of from three to five milliamperes allowed to flow. The negative electrode is kept in this situation for about a minute, and then glided to the cutaneous area just below it. In this way the entire distribution of the nerve is gone over, the séance lasting from ten to twenty minutes. As the poles are more widely separated, the current can advantageously be increased up to six or even eight milliamperes. At the end of the séance, if the patient complains particularly of the painful points in the distribution of the nerve, benefit often follows causing a current of about ten milliamperes to pass through the nerve over these points for a few seconds, the negative pole being all the time on some indifferent part of the body. At the end of each application the patient should be advised to rest for from fifteen minutes to an hour. Then he may be allowed to go about his duties or pleasures, providing the pain is not exacerbated by so doing. Different therapeutists give different instructions concerning the mode of applying the galvanic current, and undoubtedly one plan is about as serviceable as another. I have found this plan useful in both private and dispensary practice, and as it has the advantage of being simple and easy to use, recourse is not often had to any other. Naturally, in individual cases it may be modified somewhat. For instance, if there is considerable inactivity atrophy or sluggishness of the muscles physiologically antagonistic to those impaired by the sci-

atica, these muscles may be stimulated to contraction by the use of the interrupted galvanic current. The two things to be remembered are that the interrupted galvanic should not be applied to the nerve itself, and second, when applied to produce muscular contraction, the danger is of overdoing the matter. Each muscle or group of muscles should not be made to contract more than a few times; otherwise the application will be followed by painful reactions.

The next most important method of using electricity is by means of the rapidly vibrating induced current which has been conducted through a long, fine coil of closely wound wire. The battery used for this purpose is described on page 101. This variety of induced electricity is of special service in cases of subacute and chronic sciatica in which the pain is out of proportion to the attributed causation of the disease and the coexisting phenomena. The application should be made twice or three times daily immediately over the nerve, each séance lasting about ten minutes.

Static electricity has received very high praise from certain quarters for the relief of sciatica. Some time ago ten consecutive cases of sciatica coming to my clinic for treatment in the subacute and chronic stages were subjected to this form of electricity. The mode of application was that usually recommended, viz., the application of a spark from four to six inches long directly into the trunk of the nerve from the point of its escape to its terminal distributions, each application lasting from three to six minutes. The results of the trial were such as to enhance the belief previously held that static electricity was the form least deserving of confidence in the treatment of sciatica. Despite this, however, static electricity is an agency of considerable service in the treatment of inveterate cases associated with a great deal of muscular stiffness and unwieldiness of the extremity. It is an important agency to cause muscular contraction and consequent tissue metamorphosis. Aside from this the moral effects of its use and its power to produce temporary alleviation of pain justify its application, but it is senseless to rely upon it exclusively as a therapeutic agency.

Hydriatic Procedure in the Treatment of Subacute and Chronic Sciatica.—Every physician should understand the proper use of water in the treatment of ancient sciatica. There are few agencies that are more useful in this affection if properly and vigorously applied. I have already spoken of the hydriatic procedure that is serviceable in cases of acute sciatica. The most important mode of applying water in obstinate sciatica is by means of the Scotch douche. It will depend largely upon the patient's capacity to react what temperatures and under what pressure the streams be made to impinge upon the affected extremity. If the patient is anæmic, sensitive to changes in temperature, and of poor reactive capacity, it may be necessary to prepare the cutaneous system

by giving cold ablutions (water from 65° to 60° F.) for a few seconds, followed by brisk friction all over the body to cause prompt reaction, for a few days previous to the application of the douche. After the patient has been thus prepared, the douche may be applied in the beginning with water of from 110° to 60° F. and from twenty to twenty-five pounds pressure for from thirty to fifty seconds. After a few applications the temperature of the hot water may be increased to 125° F., but it is rarely advisable to decrease the temperature of the cold jet much below 60° F. At the end of the séance the patient should be given a fan douche of from 65° to 55° F. over the entire body for about five seconds. This is followed by an intense cutaneous hyperæmia, a condition that is very desirable, especially of the affected part. After this, the patient may be given gentle massage for about twenty minutes, and then allowed to dress and go out. I have found this plan of giving light massage of especial benefit in women who suffer from sciatica. Men, as a rule, do not tolerate general massage very well, and as a substitute for it in these cases, a rain bath of from 60° to 50° F. for two or three seconds is given in order to facilitate and intensify reaction. The patient is then dried quickly, and if the weather is not inclement nor the temperature very low, the patient is advised to go into the air and walk briskly in order to maintain the reaction. Such procedures as these can be had only at hydriatic institutes and hospitals provided with hydriatic appliances, but the time is at hand when such facilities must be provided in all large cities and in institutions for the treatment of the sick. If it is impracticable to use the Scotch douche, some beneficial general tonic effects may be obtained from the use of cold ablutions, which are often so serviceable in the treatment of neurasthenic conditions, and from the use of the half-bath from 75° to 80° F. for from two to five minutes, given just before retiring.

Certain thermal springs and watering-places in this country and abroad are more or less justly famous for their efficacy in the cure of all neuralgic conditions, sciatica among the rest. It should not be forgotten that the beneficial effects of a sojourn at one of these places is not more dependent upon the water and the mode of applying it than upon the change of environment, diet, discipline, and other factors that stimulate tissue metamorphosis and improve the general bodily health and neuromuscular tone. The truth of this is indicated particularly by the fact that sciatica dependent upon or associated with diathetic states, and sciatica the sequela of intoxications and infections, are more frequently and uniformly improved or cured than other varieties. The springs in this country that have a reputation for the cure of sciatica are particularly the Hot Springs of Virginia, Richfield Springs of New York, the Hot Springs of Arkansas, Mount Clemmons of Michigan, and Poland Springs of Maine. The latter two owe their efficaciousness in the relief of sciatica to the ancillary factors hinted at above. The technique of giving the

baths and water at each of these springs varies with the physicians who are in charge. It is generally combined with some such hydriatic procedure as those already detailed.

Acupuncture.—Acupuncture in the treatment of sciatica is a therapeutic measure that has been donated to us by the Chinese. They have from time immemorial practised it by thrusting fine needles of gold or silver deeply into the tissues which are the seat of pain, not necessarily into the nerve itself. It is a procedure with which I have had no considerable personal experience, but as it has recently been highly praised by several English physicians, it seems advisable to describe it and give an estimation of its worth, made by one of its latest advocates, Gibson. It is done in the following way: A single spear-pointed needle, two and one-half inches long, is plunged directly into the trunk of the nerve, particularly that part in which there is pain on pressure. The nerve should be pierced about five times before the needle is completely withdrawn. There is no difficulty in recognizing when the nerve is pierced, as it is always signalled by sharp pain shooting down the leg. The needle should not be left in for any length of time, because if it is severe pain will follow its withdrawal. A number of needles may be used simultaneously, but this is not of any particular advantage save as a time- and pain-sparing expedient. The external popliteal and musculo-cutaneous nerve may be pierced if they are the seat of points that are painful on pressure. The procedure is thought to operate beneficially by counteracting and overcoming inflammation of the nerve sheath and interstitial neuritis when the latter exists. If the nerve is pierced in a number of places over the inflamed area in which there is congestion of vessels, and consequently exudation of serum with round cell infiltration, the punctures are supposed to give an outlet to at least some of the exudation. In addition it serves to bring back the tone of dilated blood-vessels and to restore the perivascular lymph circulation which in turn aids the restoration of nutrition in the nerve.

The Use of Counter-irritants.—The means of applying counter-irritation to the sciatic nerve are numerous. That such procedure often facilitates the cure of sciatica has been attested by almost every writer from the time of Contugno (who gave the first detailed description of sciatica) to the present day. Before speaking of the methods of employing counter-irritation, remarks must be made very similar to those regarding the factors that determine the election of any procedure in the treatment of sciatica. That is, counter-irritation cannot be relied upon to benefit uniformly, unless the cases in which it is applied are carefully selected and the procedure is used discriminately. It is particularly cases of sciatica following or associated with perineuritis and interstitial neuritis that are improved by counter-irritation. Sciatica dependent upon diatheses and depraved states of nutrition should not be treated by this measure, unless there are some special reasons

for its use. The most expedient way of applying counter-irritation is by means of the actual cautery. The course of the nerve having been carefully mapped out by means of manipulation, its location is indicated by the mark of a soft lead pencil. The cautery brought to a white heat is then applied with the greatest possible rapidity, either with short, abrupt touches or by means of slight linear contact over the entire course of the nerve, except at such parts as are not covered by considerable subcutaneous tissue. The entire procedure should not consume more than a few seconds. It is not so painful as is ordinarily supposed, and if the burns are properly dressed, the after-pain is inconsequential. It is a remarkable fact, and one that brooks no denial, that when the actual cautery is applied to the skin over the nerve of the unaffected opposite extremity, the beneficial effects are quite as evident as when it is applied to the painful extremity. This can probably be explained along the same lines as can the fact that when one extremity is immersed in cold water the surface temperature of the opposite extremity drops from one or two degrees, a phenomenon dependent upon change in the vascular content of that extremity. In other words, the beneficial effect of cauterization is brought about through the sympathetic nervous system. The afferent impulse is conducted to the spinal cord and reflected through the sympathetic ganglia which preside over the vascular innervation of the extremity. The effect of a peripheral unilateral stimulus is manifest in both extremities because the sympathetic ganglia to which the impulse is reflected are functionally of bilateral display. A similar explanation might be given for the beneficial effects of cauterization of other parts of the body, such as the ear, in the treatment of sciatica. One may justly contend perhaps that cauterization of the ear, which at one time was very much lauded in the treatment of sciatica, acted because of the psychical effects which it produced; but even then the relief of the sciatic pain must have been brought about through the sympathetic nervous system which governs the nutrition of the nerve through the nervi nervorum and the vaso vasorum.

Similar effects to those obtained by cauterization may be obtained by means of blisters, produced by cantharides, mustard, or other vesicants applied over the nerve. Indeed, it is oftentimes better to apply a number of small blister plasters one inch square and one inch apart over the course of the nerve. The advantage of applying multiple blisters is that they usually necessitate the patient keeping quiet for a short time, and the compulsory rest itself is beneficial. After the blisters have formed, they should be evacuated, then treated in the same way as a burn. Mustard should never be used to cause complete blister formation, because the results of the application cannot be estimated as accurately as can other vesicants. Nevertheless, a large mustard poultice or plaster that envelops the entire posterior surface of the lower extremity from the ischiatic

notch down to the lower third of the leg, and kept on until it causes deep reddening of the surface, but removed just short of blister formation, may often be used very advantageously. In the same way, some cases of mild but obstinate sciatic pains are benefited by the application of a coating of cantharidal collodium which need not keep the patient from his occupation. Counter-irritation is a procedure that can be easily overdone in the treatment of sciatica. There is scarcely any justification for repeated use of it providing two or three trials are not followed by considerable improvement.

Nerve Stretching and Compression.—Pressure and stretching of the sciatic nerve are recommended by many writers in the treatment of the inveterate sciatica. Recently, Negro, an Italian physician, has adopted a plan which consists of making a severe mechanical pressure in the treatment of sciatica, especially in obstinate forms which are dependent upon a low grade of perineuritis. He has constructed an apparatus by means of which the pressure can be applied by the turning of a screw directly to the trunk of the nerve at any given point over which it is fastened. The block or pad that makes the pressure is fastened to a sliding horizontal bar so that when the apparatus is strapped to the leg the pressure pad can be glided up and down for a considerable distance and pressure made to any area that may be selected. The patient lies on the belly with the legs extended. The nerve is found at its exit from the sciatic notch and the apparatus applied so that the pressure pad shall come down over the nerve as nearly as possible at this point. The pressure pad is then screwed down until the patient yells, and this compression is kept up for from fifteen to thirty seconds. It is then loosened somewhat, but not completely, and slid along the horizontal bar forward and back over the nerve, thus massaging it for three or four minutes. The pressure pad may be applied over other points and especially where there is tenderness on deep-seated pressure. Usually the application is repeated after an interval of about a half an hour, and it is recommended that it should be practised about six times every day and kept up until recovery ensues. The writer makes extraordinary claims for the efficaciousness of this procedure in the treatment of rebellious sciatica. Any one who may be tempted to try it will find an illustration of the apparatus used by Arullani, a follower of Negro, in the *Neurologisches Centralblatt*, 1897, p. 584, but before electing to use it, it may be well to try simple stretching of the nerve.

The Surgical Treatment of Sciatica.—Nerve-stretching for the relief of sciatica is rather an ancient affair. At the present time the bloodless method alone has any claims for recognition. A quarter of a century and more ago it became quite common for the surgeon to expose the sciatic nerve of patients who were afflicted with sciatica which would not yield to less heroic treatment to draw it up with a blunt hook, and give

it all the tension which he thought would be good for it. Others satisfied their desire to inflict injury upon the nerve by squeezing it between the fingers or crushing with by a pair of forceps, but some went so far as to sever its continuity entirely. These barbarities are mentioned here merely to show the advance in our art. They are rarely mentioned today, except with bated breath. Slight stretching of the sciatic nerve, such as may be obtained by forcibly flexing the affected thigh on the abdomen while the knee and pelvis are kept firmly extended, is sometimes beneficial in cases of extremely obstinate and intermittent sciatica that occur without apparent cause. This is the same procedure that is occasionally of use to relieve leg pains of locomotor ataxia. Beneficial slight stretching of the nerve may be caused by firm digital manipulation of the nerve by the physician. The patient lies on the healthy side, while the affected extremity is held in a semi-extended position by an attendant. The physician endeavors to grasp the nerve after its exit from the sciatic notch at the lower border of the gluteus muscle and presses it forcibly backward toward the posterior and internal border of the thigh. It is probable that in cases of sciatica dependent upon a low grade of perineuritis and interstitial neuritis, such manipulation, pressure, and massage may be followed by considerable benefit due to breaking up inflammatory adhesions and liberating the nerve trunk from an adherent sheath and by stimulating the blood supply of the part.

In these days of aseptic surgery there is absolutely no danger in cutting down upon the sciatic nerve for diagnostic and therapeutic aid. There can be no doubt that in many instances adhesion of the sheath of the nerve and inflammatory exudate cause a violent form of sciatica and intense disorganization in the nerve which medicinal treatment is powerless to combat. The pressure of the exudate serves to prevent reparative circulation and the dragging and pressure of the adhesions keep up the persistent and demoralizing pain. Providing the pathological diagnosis is fairly established there can be no objection to such procedure. As a preliminary measure one may attempt to withdraw the exudate from the sheath of the nerve by means of a hollow needle. But laying bare the nerve is such a simple matter and so much benefit may come from it that it is urged in every case of inveterate sciatica in which one is reasonably sure that the condition is dependent upon perineuritis, thickening of the sheath, and adhesions to surrounding tissue. After the nerve is exposed further surgical procedure will be determined by the conditions found.

The Medicinal Treatment.—The medicinal treatment of chronic sciatica may be disposed of rather briefly. There are few drugs that have not been recommended. It is unnecessary to repeat here what has been said concerning the necessity of searching for the cause of the sciatica, and the adoption of causal treatment. This necessity is as great in subacute

and chronic sciatica as it is in the acute varety. Neither shall I again revert to the use of pain relievers, except to say that if the various physical measures which have been spoken of in some detail are properly used there will not be a very frequent or insistant demand for employing narcotics or analgesics. The medicines that act in an unknown way and that are given empirically are turpentine, iodide of potassium, and arsenic. By far the commonest prescription given to patients with long-standing sciatica in my clinic is an emulsion of turpentine, each teaspoonful of which represents five drops of the oil, which is to be taken in the beginning three times a day. After the patient has become accustomed to it and shows no symptoms of irritation of the urinary apparatus, the dose is increased to two or three times this quantity. Turpentine may be given in flexible capsules, in from gtt. v. to xv. doses, but it is more apt to disorder the stomach than when administered in emulsion. Iodide of potassium is a valuable medicament in the treatment of all forms of chronic neuralgia, whether they are dependent upon discernible sclerotic changes in the blood-vessels or not. The dose depends entirely upon the individual, and the well-known rules for the administration of the drug in alkaline waters or in milk should be adhered to. When there are evidences of arterial sclerosis, it should be given simultaneously with nitroglycerin or nitrite of sodium, and if the sclerotic changes are manifest in the large blood-vessels, with very small doses of digitalis. The repute which arsenic, iron, and other alteratives have gained in the treatment of sciatica is dependent entirely upon their capacity to alter and benefit nutrition. That this should be the principal object in the treatment of obstinate sciatica of any origin need not again be emphasized, nor is it necessary to enumerate the means that may be employed in reaching the desired goal. Even in cases of sciatica dependent upon conditions that cannot be remedied, such as malignant growths which exercise pressure upon the nerves, the nutrition of the patient must be persistently fortified, in order that the suffering may be better tolerated and that substances used for its relief may have something to act upon.

It has been deemed inadvisable to enumerate the various therapeutic resources that may be employed to combat sciaticas dependent upon different causes, largely in the belief that it is uncomplimentary to one's intelligence to say that quinine and arsenic should be used with all possible expedition in a patient who has sciatica and whose blood contains some variety of malarial parasite, or that a patient who has evidences of early or late syphilis should be given antisyphilitic treatment in the most approved fashion. There are certain things in therapeutics that go without saying, and such as these are of them.

Neuralgia in the domain of the sciatic plexus, aside from that already considered, occurs under one of three forms: posterior femoral neuralgia, that is, neuralgia of the small sciatic nerve, which is distributed to the

lower part of the buttocks, the posterior part of the thigh, and the upper part of the leg; neuralgia of the pudic nerve, one of the terminal branches of the sciatic plexus; and coccygodynia, neuralgia of the coccygeal nerve, or, better said, pain in the film of nerve branches which the coccygeal nerve uniting with the fifth sacral forms, and known as the coccygeal plexus. Neuralgia in the domain of the small sciatic nerve is usually looked upon as a part of ordinary sciatica, unless the pain is principally in the distribution of the inferior pudendal nerve which is distributed to the perineum. Its causation and treatment are not different from that of sciatica.

The Treatment of Podalgia.

Pain in the feet is a complaint for which the neurologist is frequently consulted, and as all forms of podalgia are extremely amenable to proper treatment, it behooves the physician to have clearly in mind the varieties of pain to which the feet are subject, as well as the conditions with which they occur. In my experience by far the most common variety of podalgia is that which is an expression of some degree of flat-foot, varying from weakness of the arch to complete pes planus. The next variety in point of frequency is plantar neuralgia not associated with weakness of the arch, occurring in patients who have syphilis, gout, tabes, or atheromatous blood-vessels, and in those whose occupation necessitates long, slow walking, such as policemen. This form of neuralgia does not seem to occur in clerks, mechanics, mill hands, and waiters, whose duties compel them to remain on their feet more or less stationary for several hours every day. It is in this latter class that podalgia of flat-foot is so common. The next commonest variety of podalgia is pain in the heel, of which two varieties are generally described: achilliodynia, usually dependent upon the presence of a bursa in the anterior part of the tendo Achillis; and tarsalgia, which is frequently associated with the presence of a subcalcanean bursa. Pain in the heel may occur apart from either of these two conditions, and be the expression of some intoxication, trauma, infection, or constitutional state, such as rheumatism or anæmia. The least common form of podalgia is a peculiar condition first described by Weir Mitchell, now known as Morton's neuralgia, after T. G. Morton of Philadelphia, who brought it before the profession in a very succinct manner a few years after reference had been made to it by Mitchell.

Morton's neuralgia, or metatarsalgia, is a neuralgia situated in the anterior part of the foot, chiefly of the fourth metatarso-phalangeal articulation, and oftentimes involving the third as well. It occurs occasionally in rheumatic and gouty individuals, especially in those whose occupation requires long standing and walking. It is essentially a pressure neuralgia, and tight boots, with narrow soles, are undoubtedly the most important factors in bringing it about, especially in persons of lowered

vitality. It may follow a blow or a strain, such as that caused by prolonged bicycling with ill-fitting boots, or in running a lathe or machine. Heredity has been thought to play a part in its occurrence, but I am sure that those instances in which metatarsalgia has occurred in more than one member of the same family are to be regarded as accidental. The essential feature in the mechanism of metatarsalgia is a collapse of the anterior arch which causes a broadening of the foot and compression of the digital nerves. The pain of metatarsalgia is liable to occur first during certain acts which cause temporary broadening of the foot, such as dancing, walking tiptoe, pedalling a bicycle, and running a machine. It is usually of an intense and paroxysmal nature and of such severity that it cripples the patient and makes walking impossible. It is relieved by flexion of the toes, by rest, and by grasping the instep firmly with the hand. Two patients who have recently been under observation had obtained relief by tying a silk handkerchief firmly about the fore part of the instep, and wearing it inside the boot. In the majority of the cases a spot intensely sensitive when pinched or pressed is found on the dorsal and plantar surfaces of the third and fourth metatarsal bones. Sometimes there is a corn beneath the head of the third or fourth metatarsal bone. The foot in some cases presents a peculiar twist directed inward just in front of the metatarsal articulation, accompanied by bulging behind the ball of the great toe.

Treatment of Metatarsalgia.—The treatment of metatarsalgia consists in overcoming the causal conditions, using measures to relieve pain and relax the painful spasmodic conditions and proper shoeing of the patient. If all these be of no avail excision of the head of the metatarsal bone, where the pain originates, should be performed. This operation should be practised in all cases in which the pain cannot be relieved by the simple and palliative measures, especially if the condition has gone on to the terminal stage. It has previously been stated that pain is often relieved by pressure, and it is therefore unnecessary to dwell upon the utilization of this, combined with rest and the immersion of the feet in hot water, and of massage regularly and methodically applied while efforts are being made to overcome the pressure on the digital nerves by supporting the arch with properly constructed shoes. It is now generally agreed that the boot should be constructed on what is known as a Spanish last: a straight inside, high instep, and an unusually long and high heel. The boot having a broad projecting sole should fit closely over the instep and be of sufficient breadth to give abundant room for the heads of the metatarsal bones, which spread out when the weight of the body is thrown upon this part of the foot. The patient may wear a rubber bandage or a leather circlet around the bases of the metatarsal bones, so as to separate the heads as much as possible. In the first stage the pain may be so severe as to require the use of anodynes, and when it does no hesitation

should be had in employing them. Usually complete rest and hot applications are sufficient to relieve the pain.

Treatment of the Podalgia due to Flat Feet.—The foot pains of pes planus are of quite a different character from those of metatarsalgia. This variety of podalgia is in reality a combination of paræsthesia, the form known as kaumæsthesia or burning sensations, and dull, aching pain which extends up the legs to the thighs, associated with a sensation of weight and unwieldiness of the lower extremities. One of the most distinctive features of this affection is the patient's manner of walking. He toes out, takes very short steps, while the weight of the body, instead of coming in a wave-like direction from the heel to the ball of the foot, is thrown directly upon the middle of the foot. Examination of the patient in the standing posture, or better still a plaster cast of the foot, will show the degree of breakdown in the plantar arch. The treatment of podalgia of flat-foot should be carried out with great thoroughness, not alone in order to get relief from the pain for the time being, but to overcome a most unsightly deformity. Next in importance to getting the patient properly shod is the adoption of exercises that will strengthen the muscular and ligamentous supports of the arch. The patient should be instructed to perform methodically the following exercise: Steadying or supporting himself by placing the hand on some firm object, such as a table or a bedpost, he should raise himself on the tiptoes, then abduct the heels as far as possible, then bring them back to a parallel and finally bring them to the floor. This should be done in one, two, three time. The exercise should not be taken at one time longer than to cause slight fatigue, but it should be repeated at least three times a day. The patient should also alternate it with forcible inversion of the feet, standing upon the outer border of the foot, therefore putting tension upon the external lateral ligament, and removing it from the calcaneo-scaphoid. Those who are obliged to stand behind the counter for several hours without resting will find that they get considerable relief by standing in this way and occasionally on tiptoe. Shoes for flat-footed persons should be constructed on the Waukenphast last. A perfectly straight inside, with the arch well supported, and if the foot be merely weak, with this part of the shoe well built up. The inner edge of the sole and the heel should be raised one lift of sole leather. If this does not suffice, the metallic supports devised by Whitman and made by R. Bendler, of 204 East Fifty-Second Street, New York City, should be used. My experience has been that these supports are by all means more satisfactory than any of the great variety that have been tried. Surgical measures undertaken for the reconstruction of the completely sunken arch have not been attended by such results that they justify extended consideration.

The treatment of other varieties of podalgia calls for no other com-

ment save the statement that causal therapy usually suffices. Plantar neuralgia yields more readily to causal therapy than almost any other variety of neuralgia, when combined with such general restorative measures as the application of water, massage, and electricity.

Pudendal Neuralgia.

Neuralgia of the perineum and of the external organs of generation is usually conditioned by functional disorder of the terminal branch of the sacral plexus, known as the pudic nerve. This nerve sends branches to the perineal space, to the external sphincter muscle, to the integument of the scrotum, to the external labium pudendi in the female, and to the penis and clitoris. Pudendal neuralgia is occasionally observed in young onanists and in others who give themselves to sexual excesses. Like irritable testicles, it is very apt to occur in those who are unstable in neural development and who manifest indications of neurasthenia and hysteria. Rarely it occurs as one of the manifestations of tabes. In women it is sometimes an accompaniment of asthenic conditions of the pelvic organs and other states of depraved nutrition. Occasionally, neuralgic pain is confined strictly to an individual branch of the pudic nerves, such as the dorsal nerve of the penis, and under such circumstances the pain may be associated with symptoms of painful sexual excitation. In other instances, it occurs in connection with phenomena of irritable bladder, prostatic neuralgia, and ovarian neuralgia, but in these cases there is usually to be found some individual or local condition which accounts for the pain and its distribution.

The *treatment* of pudendal neuralgia is in nowise different from the treatment of similar pain in the domain of the genito-crural nerve. The general condition of the patient demands careful consideration, and local abnormalities, such as narrow or adherent prepuce, urethral stricture, disease or displacement of the uterus, dilatation of the rectum, enlargement of the prostate and the like, are to be combated. Treatment directed immediately toward the hysterical or neurasthenic individual will generally be rewarded by amelioration of the local symptom of pain. Oftentimes, indeed, it is of the greatest importance that the physician studiously neglects every form of local treatment in order that the patient's attention may not be concentrated upon parts that are already occupying him engrossingly. On the other hand, if the patient be neither neurasthenic nor hypochondriacal, local measures, including heat and cold, electricity and massage, are as beneficial as in other neuralgic conditions, and they may advantageously be employed. Cases in which a hysterical element is predominant may oftentimes be brought to a speedy restoration by the application of the actual cautery or blisters, if the pain be in parts that will tolerate such measures.

Coccygodynia.

Coccygodynia, or painful affection of the coccyx, is relatively a very rare condition, although one might well be led to suppose otherwise from a perusal of the writings of some gynæcologists who have in latter years had much to say concerning the efficacy of removal of the coccyx for the amelioration of this condition. There can be no doubt that coccygodynia is of real occurrence, both in men and in women. The latter are afflicted oftener because the coccyx of woman is subject to experiences in childbirth which the coccyx of man is spared. The cause of this complaint is usually some form of trauma, such as blows and falls, bicycle and horseback riding, and exposure; disease of the bones constituting the coccyx, and certain occupations which call for prolonged use of the feet, such as in machine operators. Quite as important as the exciting causes are the predisposing causes, which can be summarized under the heading hysteria and neurasthenia. Coccygodynia leads to hysterical and neurasthenic conditions, especially if it is of long duration, and, on the other hand, these conditions seem to be favorable to its development. The cases that have come under personal observation, aside from those that have resulted from direct trauma, have been in nervous, irritable, depressed women who complain of various forms of headache, pain in the back, great muscular weakness, which was so great in two instances that it caused the patient to remain in bed all the time, and, in brief, the complex of symptoms formerly described under the caption spinal irritation. In this class of patients the affection is apt to be very intractable.

When the coccygeal neuralgia is evidently dependent upon partial or complete luxation of the coccyx, or fracture or disease of these bones, the treatment is largely surgical. The coccyx performs no physiological function in the human species, and there is very little danger connected with its extirpation. The objection to its removal in hysterical women and in neurotic people generally is that the trauma thus instituted is very liable to be followed by greater pain than was present before the operation. All radical surgical measures in the treatment of neuralgia should be left to the last, and this holds good for the surgical treatment of coccygodynia. When there are no obvious surgical indications to be fulfilled, the treatment should be directed to overcoming the neurasthenic state. It is well known that prolonged rest, massage, the application of galvanic electricity, tonic hydrotherapy, and general reconstructive treatment, combined later with indulgence in intelligent exercise, are usually sufficient to cope with this disorder. The pain of coccygodynia is usually worse during defecation, especially on straining. Laxatives by overcoming this contribute somewhat to the comfort of the patient. In men, the state of the genito-urinary organs should be investigated.

CHAPTER XXVII.

THE TREATMENT OF NEURASTHENIA.

NEURASTHENIA, or nervous exhaustion, is the name given to a complex of symptoms constituted principally by head pains and paræsthesia, insomnia, a peculiar mental state made up of depression, fear, anxiety, anticipation, and distrust; myasthenia, rachialgia, and paræsthesia; and disordered digestion and vasomotor disturbances, dependent upon disorder of the nervous organization without recognizable change. In brief, neurasthenia is a neurosis without organic basis. Many theories have been propounded to explain the occurrence of the phenomena of the disease, but none of them is entirely satisfactory. The most universally accepted one seems to be that the manifestations of neurasthenia are expressions of persistent enfeeblement of neural energy. This enfeeblement is dependent upon nutritional change in the entire neuron, or in that part of it whose function is to convert the forces of reconstruction into neural energy and store it up. That an individual part of the neuron is thus concerned has not yet been satisfactorily proven, although it seems highly probable. To discuss this theory satisfactorily, it would be necessary to consider the origin of nerve force. Such discussion would necessitate a recital of speculations and facts that is beyond my present purpose.

Etiology.—A satisfactory knowledge of the causation of neurasthenia can be obtained from careful study of the cases of this disease that come under observation. I have therefore taken three hundred and thirty-three successive cases from private and dispensary practice, and subjected them to careful study, with the view of determining the predisposing and exciting causes of neurasthenia.

Sex: Males, 183 (55 per cent); married, 96 (29 per cent); single, 87 (26 per cent). Females, 150 (45 per cent); married, 102 (31 per cent); single, 48 (14 per cent).

Age: Oldest, 67; youngest, 6; average, 33.3; most frequent decade, third.

Frequency according to decades: 10–20 years, 6.6 per cent; 20–30 years, 39.6 per cent; 30–40 years, 27 per cent; 40–50 years, 16.2 per cent; 50–60 years, 8.4 per cent; 60–70 years, 2.1 per cent.

Occupation: Housewives, 94 (28 per cent); tailors and clothing operators, 37 (11 per cent); clerks, 26 (8 per cent); indoor occupation, 264 (79 per cent).

Nationality: United States, 145 (43.5 per cent); Russia, 69 (20.7

per cent); Germany, 34 (10.2 per cent); Ireland, 34 (10.2 per cent); Austria, 15 (4.5 per cent); England, 8 (2.4 per cent); France, 2 (0.6 per cent); variable, 25 per cent.

Attributed causes: Overwork, 27; masturbation, 26; worry, 18; fright, 10; childbirth, 12; sorrow, 11; traumatism, 8; previous disease, 7; alcohol, 4. No cause attributed in 210 cases.

An examination of these statistics shows that the disease is more frequent in men than in women, although the preponderance of males is not so great as that given by almost every other writer. It occurs more frequently in the married than in the single, married women being considerably in excess of married men. This may be taken to mean that the entailments of marriage—anxiety concerning the material welfare of mate and offspring, incompatibility of partners, dread and depression attending sickness and death, the assumption of marital and maternal obligations, etc.—are contributory to the occurrence of this neurosis.

Consideration of the ages of the patients shows that infancy and senility are practically exempt. The youngest patient was six years old; the oldest, sixty-seven. The average age was 33.3. The most noteworthy feature is the occurrence of the disease during the years of fullest maturity, from twenty to forty. The epochal periods of puberty and the menopause do not seem to be particularly associated, and this is especially true of the former, with the occurrence of neurasthenia. The statistical information on this point goes to strengthen the belief that I have had for some time. Although puberty is a period in which the individual experiences new and unintelligible emotions and sensations, one in which he has to resist seductive temptations and to assume responsibilities which he is often ill-fitted by heritage to bear, these do not usually reveal their perniciousness in the production of neurasthenia until some years later. Then a comparatively trivial occurrence such as what should be an inconsequential injury, some acute disease or slight overwork is the immediate forerunner of the symptom complex of the disease, and is held responsible.

That the occurrence of neurasthenia has a very important relationship to occupation is shown by the fact that about eighty per cent. of the cases were in persons who worked indoors. This is a remarkable circumstance considering the fact that the material of the clinic, to which the majority of these patients came, is not predominantly made up of those who work indoors.

Nearly one-half of all the patients gave their nationality as American. This number, of course, includes many who should be classified as German-, Irish-, and Russian-American. The frequency with which the disease occurs in Jews is attested by the fact that, although the clientèle is not conspicuously foreign, more than twenty per cent of the entire number of cases occurred in Russian, Polish, and Austrian Jews. Indeed,

it is highly probable that upward of forty per cent of the entire number was of this race. The proportions of Germans and Irish is about equal. The Latin races are not well represented, but this is due to the fact that we see very few of these people in the clinic. It is universally conceded that neurasthenia is particularly common in these races.

Heredity would seem to play an important rôle in the occurrence of neurasthenia, for upward of fifty per cent of the cases gave a history of the occurrence of nervous disease or diathesis in the immediate ancestral or collateral family. In about ten per cent of cases there is a history of neurasthenia in one of the parents. No distinct frequent relationship between the occurrence of neurasthenia and what is known as the arthritic or rheumatic diathesis could be made out. Special reference is made to this point, because the modern French writers lay great stress upon the rôle played by the neuro-arthritic diathesis in the causation of neurasthenia.

Although the patients were all questioned as to the attributed or exciting causes of their symptoms, specification of such causes could be got only in one hundred and twenty-three cases. The remainder averred that they were quite ignorant of the factors that could be held responsible for their sickness. Of these one hundred and twenty-three cases, overwork and masturbation are apparently responsible for the same number, while mental factors, particularly emotional, such as worry, fright, strain, and sorrow, were given as the cause in about one-third of all the cases; physical injury and acute disease were believed to be the exciting agencies in a number of cases.

It is not overwork alone that is so pernicious, but the worry and anxiety that are entailed by the assumption of grave responsibilities and obligations without adequate preparation and sufficient support. The emotional element in such cases is a very important one. The infectious diseases, by depreciating vitality and by throwing into the economy an amount of toxic material which it must battle with for a longer or shorter time, are responsible for a considerable amount of neurasthenia. They are operative to this end particularly in those who inherit the neuropathic diathesis.

Perhaps the most remarkable feature of the statistics bearing on the matter of the exciting causes of neurasthenia is that alcohol and tobacco were not admitted or noted to be causative of the disease except in very few instances. This is in fullest accord with previous personal experience and belief based theron. Some writers have claimed that excessive indulgence in alcohol, tobacco, tea, coffee, narcotics, and other intoxicants plays a leading rôle in the causation of neurasthenia. With full appreciation of the perniciousness of these substances upon the nervous organization, and recognition of their great potentiality for mischief to this and other systems of the body, I repeat that they manifest their peccant

activity upon the economy in other ways than in the causation of neurasthenia.

The relation of auto-intoxication to the development of neurasthenia is a question to which much attention has been given. Many writers believe that undue retention in the alimentary tract of partially digested foodstuffs and the subsequent absorption into the system of toxic substances manufactured therefrom is the starting-point of the disorder that eventually overwhelms the nervous system. Others, amongst the most conspicuous of whom is Haig, maintain that the disease is generally due to an accumulation of uric acid in the tissues, due to diminished excretion which is brought about by an increased acidity of the blood on account of the presence of an excess of acid salts and other products of nitrogenous metabolism. The importance of these factors in causing neurasthenia is gradually becoming discredited. Disorders of metabolism are rarely the sole cause of neurasthenia. Oftentimes the manifestations of such disorder are the effect of neurasthenia through the sympathetic nervous system and not the cause as so many writers would have us believe.

The effect of masturbation (under which are included for convenience' sake other irregular forms of sexual indulgence) is generally recognized as being very important. The statistics here given corroborate this view.

In a few instances pelvic disease in women and disease of the genital organs in men have clearly an etiological relationship to neurasthenia. Occasionally it occurs after frequent pregnancies and prolonged lactation. In such cases it is an expression of exhaustion.

Of the various causes that have been enumerated, some are all-important in one case, some in another. They are not by any means of equal neurasthenia-causing capacity, and no one can say beforehand whether one of the above-mentioned factors, or all of them, will cause neurasthenia in a given individual. It depends entirely upon the individual and upon his resistance capacity, which in every one is subject to unexplainable variations. Certain persons are so vulnerable that the equilibrium of their nervous systems is quickly upset by the occurrence of any of these causes; while others have a nervous organization so stable and so susceptible to the aid of reconstructives that they resist successfully one and all of them during an entire lifetime. Therefore, it may be said that the etiology of neurasthenia depends more upon the individual than upon anything else. Thus it is that heredity plays such an important rôle in the occurrence of neurasthenia. If one is born with a nervous system that is deficient in the capacity to produce neural energy or, what is the same thing, to maintain a proper equilibrium between production and expenditure of such energy, such a person is far more liable to develop neurasthenia as the apparent result of any of the exciting causes that I have mentioned than is another person whose inheritance is a stable nervous organization.

Symptoms.—The symptoms of neurasthenia will not be considered save as they are indicated in the following summaries showing the relative frequency in percentages of symptoms that are so constant in neurasthenia that they may be called stigmata.

1. *Psychical symptoms:* Static depression, 22.2 per cent; variable depression, 19.5 per cent; lacking mental concentration, 13.8 per cent; mental confusion, 10.8 per cent; undefinable fear, 8.4 per cent; excessively irritable, 7.5 per cent. Exaggerated sensitiveness and morbid reserve, 5.3 per cent.

2. *Headache:* A leading symptom in 55.8 per cent (occipital, 10.8 per cent; frontal, 8.1 per cent; vertical, 7.8 per cent; diffuse, 26.7 per cent).

3. *Sensory symptoms:* General pains, 30.3 per cent; vertigo, 14.1 per cent; pains in the back, 12.3 per cent; acroparæsthesia, 12 per cent; paræsthesia, 11.1 per cent; epigastric pains, 5.7 per cent.

4. *Sleep:* Insomnia, 70 per cent; dyssomnia, 10 per cent; undisturbed, 20 per cent. The classification includes two forms: First, great lassitude and profound mental torpor after eating followed by restlessness and sleeplessness after one or two hours' sleep; and second, wakefulness and other phenomena of disturbed sleep without introductory somnolency.

5. *Motorsym ptoms:* Myasthenia, 37.2 per cent; twitchings, 2.7 per cent; tremor (as a complaint), 3.3 per cent.

6. *Vasomotor symptoms:* Palpitation, 22.8 per cent; cold extremities subjective and objective, 34 per cent; hot flashes, 9.6 per cent; pseudo-angina, 1.5 per cent; pulsation in the neck and head, 4 per cent; pulsating, fluttering feeling in the abdomen, 28 per cent; epistaxis, 0.9 per cent; polyuria, 4 per cent. Profuse sweating paroxysmally, 3 per cent.

7. *Digestive symptoms:* Stomachic indigestion, 18.3 per cent; intestinal indigestion, 13.3 per cent; poor appetite, 22.2 per cent; good appetite, 26.7 per cent; variable appetite, 21 per cent; appetite not noted, 30.1 per cent; constipation, 27.3 per cent; stools regular or loose, 28.8 per cent; stools not noted, 30.1 per cent; coated tongue (noted), 6.6 per cent; mucous diarrhœa, 3.5 per cent.

8. *Sexual symptoms:* Nocturnal emissions, 19.1 per cent; impotence, 3 per cent; partial impotence 18.5 per cent; loss of sexual desire, 23 per cent; loss of "vital" fluid on urination and at stool, 5 per cent; premature ejaculation, 1.2 per cent; persistent masturbators, 3.5 per cent; extreme prostration after coition, 10.2 per cent.

9. *Initial symptoms:* Headache, 27 per cent (vertical, 3.6 per cent; frontal, 3.2 per cent; occipital 6.6 per cent; diffuse, 12.6 per cent). General pains, 8.7 per cent; myasthenia, 7.5 per cent; epigastric distress, 7.5 per cent; insomnia, 5.1 per cent; melancholia, 3.3 per cent; vertigo, 4.2 per cent; palpitation, 1.8 per cent; pains in the back, 1.8 per cent; acroparæsthesia, 1.5 per cent; unclassified, 26.4 per cent.

10. *Physical signs:* Reflexes—knee jerk exaggerated, 22.2 per cent;

knee jerk diminished, 3.3 per cent; knee jerk normal, 74.4 per cent; absence of the pharyngeal reflex, 8.7 per cent. Tremor—of fingers, 30 per cent; of eyelids, 8.4 per cent; of lips, 6 per cent; of tongue, 1.8 per cent. Weight—loss of flesh in 30 per cent of the cases. Skin—dermographism, 35 per cent; red ears, 4 per cent; pale skin, 18 per cent. Pulse—high tension small volume noted in 91 cases. Evidences of arterial sclerosis in 24 cases. Displacement of some of the abdominal viscera—enteroptosis, 4 cases. Pupils—dilated and sluggish on exposure to light, 4 per cent. Neuromuscular system—local tenderness on pressure, indefinitely distributed, 27 per cent.

Treatment.—In discussing the etiology of neurasthenia the conclusion was reached that the individual who developed the symptom complex was, after all, first in the scale of importance. In the treatment, as well, individualization is more necessary to insure success in this than in almost any other disease. Although there are certain agencies of reconstruction—such as diet, hydriatics, massage, rest and exercise, change of environment and climate—that are beneficial in almost every case, their application, at least their most successful application, is scarcely ever the same in two cases; so that which is said concerning treatment must be taken to mean that it must be varied to meet the needs of each case.

Prophylactic Treatment.—Since the occurrence of neurasthenia has been shown to stand in close and definite relationship to certain predisposing and exciting conditions already named, it is evident that the preventive treatment is an important consideration. I am not of those who believe that neurasthenia is a disease of the epoch or that it has occurred only in modern times. Nevertheless, to a certain extent it is a sign of the times. There can be little doubt that, although the exciting factors of neurasthenia have always existed, the predisposing causes are mainly of more recent date. Neurasthenia has become more common as social, political, and economical conditions have made the struggle for existence more violent and the prospects of a quiet life more perilous. So long as such conditions exist and so long as mankind assumes, through choice or necessity, to cope with them, just so long will neurasthenia continue to occur, unless by progress of evolution the human species becomes more able to resist these factors. As there seems to be little chance that evolutionary progress will hurl itself into the breach, it becomes necessary for the individual that he may withstand the strife, to adopt measures that will tend to fortify his neural resistance and equilibrium. Such fortification is the more necessary to him who is handicapped by heritage with an unstable nervous organization. The preventive treatment of neurasthenia should be begun simultaneously with the development of the individual. And the rules given for the general moral and physical hygiene and training of neuropathic children in Part I.

apply with particular force to the preventive treatment for neurasthenia in such individuals.

What is there said concerning the prevention of the neuropathic diathesis should be read in this connection.

The prophylaxis of neurasthenia consists, in reality, only in avoiding those factors which it has been proven by experience cause the development of this neurosis. When once the neurasthenic state is developed the physician is not in a position, in the majority of cases, to advise the patient how to arrange his life and labors so as to avoid an attack of neurasthenia. He may, however, do much to prevent the recurrence of the attack. Once the disease has occurred and been recovered from, it is very liable to relapse. If it is kept in mind that it is not so much physical and mental work or overwork that causes neurasthenia as it is worry, anxiety, depression, and resulting sleeplessness and disordered digestion, the patient may be shown how to avoid a relapse, even without curtailment of the labors and activities that are necessary for existence.

Treatment of the Attack.—The treatment of neurasthenia after the disease has developed requires for its successful outcome a deeper insight into, and understanding of, mankind than does that of almost any other bodily or mental disease. The physician who has the good fortune to inherit or acquire such discernment will be immeasurably more successful than he who is without it and at the same time master of physiology and materia medica. Nothing is more certain than that the patient's mind requires as much or more treatment than the body and its functions. There are many reasons that will explain this; but the truth of it is evident to all who understand the important rôle played by the mind, the stress and abuse of it, in the development of neurasthenia, and the different manifestations of mental asthenia throughout the course of the disease. The introspectiveness, anxiety, indefinable fear, painful foreboding, keen sense of incapacity despite the pressing need for action, the mental depression with its train of morbid thoughts, sleeplessness, and perpetual unrest, all are no doubt lessened and sometimes overcome by the use of physical restorative agencies alone, but they are much more surely and frequently eradicated by the simultaneous use of the proper kind of psychical and moral treatment. Such treatment does not depend upon the use of means that appear to the patient to be supernatural, such as hypnotism, neither does it necessarily consist of explanation or exhortation. Of the very greatest importance is the confidenc which the successful physician inspires in his patients and the maintenance of his authority as proved by their obedience to instructions and amenability to suggestions. And such psychical influence can be made most effective when used through the medium of the physical measures which experience has shown to be so serviceable in the treatment of neurasthenia. These measures are powerful agencies for suggestion, and as the neu-

rasthenic is in a psycho-physical state of increased suggestibility, they furnish fruitful soil for all kinds of suggestion. Next to the influence of the physician, the most important measures for the treatment of neurasthenia may be considered under the following headings:

(1) The general hygiene of the neurasthenic. (2) Dietetics and alimentation. (3) Hydrotherapy and balneotherapy. (4) Electricity. (5) Rest, exercise, massage. (6) Climatotherapy. (7) Mode of treatment, disciplinary or moral hygiene.

General Hygiene.—The general hygiene of the neurasthenic patient includes the avoidance or removal of everything that tends to emphasize or to remind him of his infirmities; change from associations and surroundings which seem to be causing or maintaining the neurasthenic condition to others that will favor mental equanimity and general quieting of mind, and help to restore nutrition. Without these, the treatment of neurasthenia, especially if the disease is of a severe type, is often foreordained to failure. The physician who strives for the fulfilment of these indications before attempting the methodical treatment of the patient will have immeasurably greater success than he who neglects them. In many instances, unfortunately, the patient's social and financial state offers an unsurmountable obstacle. In fact it may be said that a long, well-filled purse is a powerful therapeutic factor in the treatment of neurasthenia. In dispensary practice, where neurasthenia is seen oftener than are all other kinds of nervous diseases, the problem that has to be continually met is to find a substitute for these indications. That such a one has not been found accounts for the fact that the treatment of neurasthenia among the poor is still woefully unsatisfactory.

Isolation and Discipline.—The indications just mentioned require for their fulfilment relatively complete isolation, which can rarely be had at home, unless a part of the house can be set apart for the exclusive use of the patient and the attendant. Even when this is possible there are many reasons why it is better for the patient to be lodged in a boarding-house, hotel, or house conducted for the purpose. Such isolation acts beneficially in many ways: it removes the patient from the sympathizing family and friends, who are ever ready to indulge him in numberless selfish acts and deeds which are invariably harmful, and to question solicitously about the many real and imaginary ailments that make up the symptom complex. Moreover, it takes him away from surroundings that not only remind him of his illness and incapacity, but that tend to make him more self-centred and selfish. It serves to break up injurious customs and pernicious habits, and more than all, to impress him that something is being done earnestly to bring about recovery. Many patients, especially women and their friends, are firmly convinced when such a step is proposed that carrying it through would be tantamount to driving them mad. They argue that such a plan may be suited to others, but, consid-

ering the peculiarities of their mental constitution and certain necessaries for the continuance of even a miserable existence, the step is unfeasible beyond debate in their own case. Oftentimes this is the first opportunity for the physician to display that insight into the human mind which I have already spoken of as being so essential in the treatment of this disease, and his power to inspire confidence and secure obedience. He knows from experience, and from the statement of others, that such relative isolation is seldom if ever injurious to even the most sensitively organized person, and that it almost always conduces to the quietude, peacefulness, rest, and improvement of nutrition that are needed to restore health. Very rarely does the step increase the patient's introspectiveness and make him more conscious of his symptoms, anxieties, and fears. Of course it is not necessary for every neurasthenic to be isolated. In many cases it will be sufficient to insist that he withdraw for certain times during the day to the quiet of his own chamber; to give over certain occupations or duties which call for the expenditure of energy that cannot be spared; or to postpone the time for arising until midday. In the very severe case, however, no compromise in the matter of isolation should be made. It is an essential feature in the rest cure, which I shall speak of later in the treatment of neurasthenia, but here it is being considered aside from any other part of the treatment. Isolation may be carried to excess, both in point of completeness and in duration. There can be no doubt that prolonged isolation, if not counteracted by other means, is of itself sufficient to cause neurasthenia. The lesson to be learned from this is that individualization is very necessary in the treatment of neurasthenia in regard to the general hygiene.

The Securement of Sleep.—The next most important measure in the general hygiene consists in securing a proper amount of sleep, and as insomnia is one of the most constant stigmata of neurasthenia, this is often a difficult thing to accomplish. In many cases the use of means that tend to improve general nutrition and physical rest—such as hydriatics, electricity, massage, gymnastics, exercise, or enforced rest—help materially to overcome the insomnia, especially if they are aided for a short time in the beginning by the administration of sulfonal, trional, chloralamide, or one of the other modern hypnotics. As a rule, the patient has already exhausted the sleep-producing capacities of such drugs before coming under treatment; but despite this, when given under the auspices that are being described, they rarely fail to have a degree at least of the desired effect. Often the physician is too impatient to get prompt effects from the use of sleep-producing medicines, or from such measures as massage, the cold pack, and drip sheet. It should not be forgotten that less sleep is required with absolute physical rest than is necessary under ordinary circumstances. Moreover, physical measures that aid sleep may not succeed fully after the first few trials, while success crowns their

repeated use. Of the hydriatic measures, the most important in securing sleep are the cold wet pack, the prolonged warm bath, the drip sheet, and the wet compress known as the Neptune girdle. The latter, which consists of a bandage of coarse linen reaching around the entire lower part of the trunk, and fastened in front so that the abdomen has a double covering, is wrung out of water of 60° to 65° F., and covered with a dry bandage. Applied on retiring after the parts have been bathed with cold water this simple means is often successful in producing sleep. The prolonged warm bath, temperature 95° to 100° F., the patient being kept in from twenty to forty minutes, is likewise very serviceable in bringing about relaxation of mind and body preparatory to sleep. The drip sheet —which is applied by throwing a linen sheet, loosely wrung out of water at 65° F., around the patient, who stands in a foot tub of comfortably hot water with a Turkish towel wrung out of iced water about the head; then bringing the sheet in apposition with every part of the skin by a few quick rubbings of the attendant's hand; the sheet being then removed and the patient dried and reaction aided by light massage or rubbing—is often effective in overcoming insomnia. These hydriatic measures should be tried in succession. When one does not succeed it is very likely that another will. Some neurasthenic patients have no difficulty in going to sleep early in the evening, but awake after a profound, unrefreshing sleep of two or three hours, to remain awake for the rest of the night. In such a case, especially in women, severe massage of the entire body, of about an hour's duration, sometimes causes the patient to sleep. In others the hydriatic measures above mentioned are successful. Occasionally the administration of from six to twelve ounces of warm milk, plain or peptonized, seems to have an effect in bringing about mental and physical composure which aid sleep. In cases of this kind it may be advisable to prevent the patient from going to sleep just after the evening meal, so that the customary hour for sleep will find him more ready.

Dietary of Neurasthenics.—The diet of the neurasthenic patient will depend largely upon the state of his digestive functions and upon the type of neurasthenia. Certain neurasthenics whose fears, thoughts, and anxieties are mainly of their viscera, and in whom careful physical and chemical examination show no great abnormality either of the digestive system or its contents, are made more self-centred and gloomy if much stress is laid upon the diet or attempt made to change or regulate it. Such patients should be advised to satisfy their appetites for food as if they were robust, and to partake especially of coarse, green vegetables, which will have an effect to produce large and ready evacuations. They should be urged also to drink water freely. In other patients there will be found slight derangement of the digestive functions, such as temporary excessive acidity or diminished acidity of the gastric juice, stomachic and intestinal fermentation, sluggish vermicular action, and flatulency,—

which easily respond to the administration of the indicated symptom medicines, particularly if general treatment for the neurasthenic state is given at the same time. Patients when first coming under observation frequently dwell upon the fact that they have been under the treatment of a number of physicians, usually specialists, for the relief of first one symptom and then another, and they produce a package of prescriptions to show the amount and variety of medicines that they have taken to overcome what seems to them, and apparently also to those who have treated them, their ailments. Such efforts may be compared to an attempt to mend a shattered fence without first repairing the foundation.

In some neurasthenic patients the general asthenia is shown chiefly in the digestive tract, and we have to deal with a gastro-intestinal atony, whose prolonged existence leads to dilatation of the stomach and the intestines. The results of such conditions are that the viscera are unable to pass the ingesta along with proper facility and thoroughness. This, together with insufficient secretion of the digestive juice, which is indirectly dependent upon the atony, leads to fermentation and to the formation of substances which are injurious when absorbed into the system. Such fermentation and auto-intoxication cause symptoms which the patient believes to be very serious, and this adds to his mental depression and strengthens the belief that recovery is hopeless. The indications for local treatment in such a case are to be determined by means of a test meal, that it may be observed how long it takes the stomach to pass the food into the intestines, and that the contents of the stomach may be removed for analysis to show the relative proportions of the constituents of the gastric juice. After this information has been obtained, and after the stools have been subjected to scrutiny to determine whether they contain undigested foodstuffs or are of shape and size pointing to impaired activity in different parts of the large bowel, the physician is in a position to decide what local or symptomatic treatment is required. To name the different substances that must be used to fulfil special indications in certain cases would not be profitable.

The most important step in overcoming the gastro-intestinal asthenia which is primarily at the bottom of all digestive disorders is the use of physical measures which experience has shown to be so valuable in the treatment of neurasthenia. The patient should be assured, repeatedly and convincingly, that he has no organic or incurable disease. Careful observation should be made to find out what foodstuff disagrees with the patient, and this, with all things that are difficult to digest, should be forbidden. As a rule, a mixed diet is best for the neurasthenic patient, but meat should not be given more than once a day, and then only in the most digestible forms. Cereals, such as rice, sago, cracked wheat; green vegetables, such as spinach, string beans and celery; peas, fresh beans, and potatoes, in purée form, can be taken by almost every neurasthenic. As a rule, white

vegetables are to be avoided. Bread is to be taken in moderation, and preferably in the shape of bread made from the whole grain, toast, and zwieback. Frequently regulation of the amount of bread is of the greatest importance, as a considerable proportion of these patients have starch indigestion. Care must always be had in estimating the amount of fats that can be given to a neurasthenic, because they not only tend to disorder the digestion, but by causing satiety they stand in the way of other and more important foodstuffs, such as the vegetable proteids. Sufficient fats can usually be given in the shape of milk, butter, and cream. Patients who believe they have an idiosyncrasy for one or two of these may be able to take the other. The best way to give cream is in the form of cream toast, which is prepared by taking a piece of thoroughly toasted bread, sprinkling it with a few drops of water and a pinch of salt, and then pouring over it a thick layer of cream fresh from the icebox. Neurasthenic patients can usually take this once or twice a day without interference with their appetite or digestion. When the patient can tolerate it, milk, or some preparation of it, should be given to supplement regular meals. Personally I have found the best time to administer milk to be one-half hour before eating or two hours after a meal. When it is given a half-hour before a meal, and the patient is told to keep absolutely quiet until meal-time, it very often seems to have no effect whatever in depreciating the appetite. Many writers on neurasthenia contend that three times a day is often enough to feed neurasthenic patients, but this is not my experience. Many of these patients have their only minutes of well-being for a short time after each meal, while, on the other hand, they are usually much depressed by going without food for several hours.

The dietary indications that have thus far been spoken of apply to the neurasthenic person who is not afflicted with other disturbances of the gastro-intestinal tract than those named. Unfortunately, from five to ten per cent of all sufferers from this disease present some graver form of gastro-intestinal atony and its accompaniments. These require very particular treatment, as the disorder of general nutrition which they bring about stands obstinately in the way of regaining the neural equilibrium. The most uncommon of these graver forms of digestive trouble is that kown as hyperchlorhydria, associated with slight or considerable dilatation of the stomach. When this, associated with the neurasthenic state, occurs in elderly persons, it is one of the most difficult conditions to overcome. It should be treated by regulating the diet, by cutting down the animal proteids, and increasing the vegetable proteids and easily digested starches, by giving milk, preferably at bed-time, in connection with some alkali, such as bicarbonate of sodium in from twenty to sixty grain doses, and by alkaline drinks such as natural Vichy. Intestinal fermentation should be counteracted by occasional small doses of calomel,

followed by one or more doses of Carlsbad salts and by the uninterrupted administration of ichthyol, one of the bismuth preparations, resorcin, etc. A usual formula is the following:

℞ Valerian. salicylat.,
Pulv. rhei, ... āā ʒ iiss.
Ichthyol, ... ʒ i.
M. ft. caps. No. xxiv. S. One capsule t.i.d.

Despite all that has been and is still claimed for the modern antifermentatives, in my own experience $\frac{1}{20}$ to $\frac{1}{10}$ gr. of calomel two or three times a day is by all means the most reliable substance to prevent intestinal putrefaction.

The most important elements in the treatment of so-called neurasthenia gastrica are regulation of the diet and the administration of a suitable amount of alkali, except where the condition be one of hyperchlorhydria when such alkaline administration would be decidedly injurious. In addition to the general treatment to overcome the myasthenia, the galvanic current may be applied to the stomach through the abdominal parietes, or better by the intragastric method of faradization or galvanization. In my own experience the latter method has shown itself of greater service than the former. Very little benefit is to be had from the use of some constituents of the digestive fluid, artificially prepared, such as pepsin and pancreatin. If they are used at all, it should be for only a few doses. Many neurasthenic patients come to the physician with the history that they have been in the habit of washing out the stomach regularly for many months. On general principles it may be said that such practice should be stopped at once. Also it may be said that the only condition that justifies repeated washing out of the stomach is one of chronic gastric catarrh, with an accompaniment of considerable secretion of mucus. Even in such a case it should be alternated with intragastric electrization and frequently intermitted and large draughts of warm or hot water given instead.

Constipation accompanies the disease in the majority of cases. In about five per cent of all cases there is a history of symptoms that leads to the diagnosis of mucous enteritis, the prominent accompaniments being irregular diarrhœa with variable amount of mucous discharge. To overcome the constipation is not usually a difficult task, if the physician keeps in mind that the two main causes of it are sluggishness of vermicular action, a manifestation of myasthenia, and deficiency in the watery constituents of the stools. To overcome these it may be necessary to employ, in addition to the general treatment for neurasthenia, abdominal massage, such drugs as strychnine and belladonna that cause contraction of unstriped muscular fibre, in connection with laxatives, while the second factor in causing constipation is thwarted by having the patient take freely of water and of substances that lend bulk to the stools. If this is not

sufficient, my experience has taught me to rely upon enemata of olive oil or cotton-seed oil, administered to the patient in the knee-chest position, through a tube which is carried beyond the junction of the rectum and the colon. From six to eight ounces of oil are introduced very slowly, and after the patient has become somewhat accustomed to the procedure there is no difficulty in retaining it. It should be repeated about every fifth day. The phenomena of mucous enteritis are best combated by the use of the Neptune girdle externally, and by copious flushings of the large intestines with plain water or with water to which some alkali or antiseptic, such as boric acid, has been added. These cases require careful selection of the diet and regulation of the amount of food that can be profitably given. In some cases in which the taking of food is immediately followed by a desire to go to stool, with the voidance of a small amount of fæces and a large amount of mucus, the occasional administration of one of the bromides is beneficial.

Neurasthenia occurring with excessive formation of uric acid, or relatively defective elimination of this substance, requires special dietary treatment. The details of such treatment will not be given here, as it differs in no wise from the approved dietary treatment of any of the manifestations of the uric-acid diathesis. The most important thing to be borne in mind is that too strict insistence on an anti-uric-acid diet may prevent the recuperation of nutrition upon which recovery from neurasthenia depends.

The Interdiction of Stimulants.—The physician's course in determining whether or not alcoholic drinks, tea, coffee, and tobacco, shall be taken, is shaped very largely by the patient's habit and reaction to these substances. If the development of the neurasthenia stands in any relationship whatever to such indulgence, they should be absolutely excluded. If, on the other hand, the patient has been accustomed all his life to taking a small quantity of light wine or beer at meal-times, and if such indulgence seems to help the appetite and digestion, the indications favor the continuance of the habit. Nevertheless, it may be stated as a general rule that all of these substances tend to derange digestion rather than to aid in restoring it, and they should therefore be avoided. Malt liquors especially seem to have the capacity to start fermentation. I have not been able to convince myself of the reputed reconstructive and nutritive qualities of any of the malt extracts. They may sometimes help to create an appetite, but they can be satisfactorily replaced, and without any of their disadvantages, by the use of simple bitters.

Hydriatic Treatment.—The value of hydriatics in treating neurasthenia can easily be overestimated. They are, nevertheless, perhaps the most important of the physical measures upon which experience has taught us to rely. It owes its good effect to the powerful appeal that it makes alike to the body and to the mind. It greatly aids constructive

metamorphosis by stimulating the peripheral and deep circulatory fluids; it is an important agency to excite and to quiet the peripheral nerves and their central and peripheral distribution; its use almost always gives at least a temporary feeling of well-being, caused by reaction, and this makes an impression upon the patient's mind helping to restore the lost confidence and to overcome the mental depression which play such a leading part in the disease. In these ways and others it overcomes the myasthenia, it promotes the appetite and facilitates digestion, it aids rest and sleep, and it tends to overcome the numerous paræsthesiæ which form such a conspicuous feature of the patient's complaint.

The method of using water to advantage in the treatment of neurasthenia varies with the individual, and particularly with his ability to react. It therefore varies with the same person in different stages of the disease. There is no such thing as a fixed hydriatic prescription, because what may be good for one patien't will very likely be injurious to the next. When the conveniences of a hydriatic institution are to be had, the physician should avail himself of them, because there water can be applied more carefully and accurately, while the seemingly complex apparatus makes a leading appeal to the patient's mind, a result at all times to be striven for in the treatment of neurasthenia. The possession of such hydriatic apparatus is one of the most important claims in favor of sanatoria treatment of neurasthenia. Much benefit, however, may be gained from the use of cold water with no other apparatus save the attendant's hand, a pitcher, and a sheet. The usual hydriatic measures in the treatment of neurasthenia are cold ablutions, the dripping sheet, the spray, and the simple douche. Of these the latter is by far the most important. In order that the douche may be used successfully, a certain amount of pressure which can be readily graduated is necessary. For the average neurasthenic person of the depressed type, the customary method is to prepare him for the douche by a few treatments with cold ablutions (80° to 65° F.), the water being applied from the attendant's hands, accompanied by brisk friction, while the patient stands in warm water, with a cold compress about the head. If the patient reacts well after being dried and made to take lively exercise in the open air, or after having been put to bed, the cold-douche treatment may be begun. When the patient is sent to an institution, some such method as the following is used: the cutaneous circulation is stimulated by encasing the patient's body up to the chin either in a hot box or in dry hot sheets for a few minutes, but never up to the point of considerable perspiration, except in the irritable varieties of neurasthenia and in those accompanying the uric-acid diathesis; the douche is then applied all over the body with from ten to fifteen pounds pressure, and with water from 85° to 55° F. The treatment is then ended by the application of a spray (called the Fleury spray, after its French originator), with water of about the same or a little higher tem-

perature and with equal or somewhat greater pressure. The patient is then quickly dried and reaction aided in the usual way. It depends entirely upon the degree and completeness of reaction what the formulary for the next treatment will be. If reaction is satisfactory, the temperature of the water is diminished on each succeeding day and the pressure somewhat increased, but never above eighteen or twenty pounds. The Scottish douche is rarely used, unless it be for the purpose of counteracting neuralgic pains and painful paræsthesia.

When the hydriatic treatment must be carried out at home, cold ablutions and the dripping sheet are most serviceable. The former may be applied in two ways, either of which is very simple. A linen sheet is wrung out of water from 75° to 65° F., and thrown about the patient, who is standing upon a warm, dry surface or in warm water; then the attendant makes friction for from thirty to ninety seconds through the sheet, which is then changed for a dry sheet, through which frictions are kept up until the patient begins to react thoroughly. The reaction is then kept up by use of the customary measures. The dripping sheet is often more useful than the one just described. The linen sheet is thoroughly saturated in water of the same temperature, but is not wrung out. It is applied in the same way after the patient has been given a brief ablution with water of the same or somewhat higher temperature, and taken off after from thirty to sixty seconds, during which time friction is kept up through the sheet.

The other applications of water, such as the prolonged lukewarm or warm bath, the half-bath, the local and general cold pack, may be used to meet special indications. In the forms of neurasthenia characterized by erethism, mental excitement, motor unrest, and continual expression of dissatisfaction, the general cold pack repeated once or twice daily, and kept on from two to four hours, is a very important and helpful measure.

The Use of Electricity.—The usefulness of electricity in the treatment of neurasthenia is much less than that of water. A discussion of the mode of its beneficial action does not seem necessary. The belief seems to be growing that its power for good depends largely upon its effect in making a psychical appeal to the patient. Its unknown nature, its wondrous manifestations, its attributed health-restoring qualities, all tend to impress the patient with its power for benefit. It really matters not how it acts or upon what it acts, so long as it may be utilized for the patient's good. Nor does it matter particularly in what form electricity is used. The form that appeals most powerfully to the patient's emotion and that is given from the most complicated and elaborate apparatus, according to the most studied plan and with the greatest care, is the one that will have the best effect. It is because these essentials are best provided by the static apparatus that the application of this form of electricity seems to be of more benefit than either the faradic or galvanic. The next most useful form of electrization is the electric bath. I do not mean to deny that faradic and gal-

vanic electricity are sometimes useful in neurasthenia, by virtue of certain physical properties which they possess, to assist in overcoming certain conditions, such as pain and myasthenia. For instance, general faradization, if not carried to the point of fatigue, may be of considerable help in giving tone to the relaxed muscles. On the other hand the rapidly interrupted current may sometimes be used advantageously to counteract pain and paræsthesia, while the positive pole of the constant current is now and then useful in overcoming local pain, such as rachialgia. The latter current should never be used about the head, because of the vertigo that it is liable to cause, which may be fastened upon by the patient as a new symptom, and, sinking into a morbid memory, will but add to his suffering. Formerly the use of faradic electricity, to produce muscular contraction and therefore make for change of tissue, was thought to be very essential in the rest cure; but it is gradually being given up in favor of massage, passive exercise, and graduated active exercise, although it is still used for its effect as an indirect psycho-therapeutic agency.

Rest, Exercise, and Occupation.—The use of rest, exercise, and massage in the treatment of neurasthenia will depend largely upon the individual and the type of the disease from which he suffers. In some cases absolute rest in bed for a number of weeks is a very essential part of the treatment. Particularly is this true in the case of women who are run down from social, maternal, or household duties, and in that of both men and women in whom neurasthenia follows some such exhausting experience as prolonged suffering, repeated illness, protracted attention to the claims and wants of others, especially when associated with anæmia and more or less loss of flesh. In my own experience the rest plan of treatment is applicable to a relatively small proportion of all neurasthenics, when carried out in a radical way. A modification of it is, to be sure, one of the necessary features in the plan of treatment which I am attempting to outline. But in many cases it is better to prescribe some exercise that is consistent with the patient's strength and purse, in connection with a certain amount of enforced rest in bed. In beginning the treatment of a severe case of the anxious, depressed type of neurasthenia, it is as a rule advisable to keep the patient in bed for two or three weeks, during which time the use of massage and resistance movements give the exercise necessary to combat the myasthenia and to aid tissue reconstruction. After such a time the patient is kept in bed from fourteen to eighteen hours out of the twenty-four, the remainder being taken up in hydriatic and electrical treatment, walking, cycling, golfing, riding, fencing, boxing, rowing, etc., whichever is most feasible and suitable to him. The kind of exercise that is best in neurasthenia depends somewhat upon the type of the disorder, but more upon the individual. The greatest difficulty is met in finding the exercise that is most suitable for women who, from one end of life to the other, have never tasted the sweet weariness

that follows accustomed toil or whose age precludes them from indulging becomingly in the varieties of exercise that I have mentioned. For them walking is tedious and lends itself to introspection; cycling is looked upon as unfitting their years and dignity; golfing is too spectacular and violent; and so on through the list. It is in such a case that the patient should be sent into some new country, especially a hilly or mountainous one, whose attractions invite exploration which necessitates walking, climbing, and riding.

The effect of exercise on the mind of the neurasthenic patient can be easily explained. In a normal individual, the mind offers a barrier between impressions received through the senses and all external and internal manifestations of them. It thus closes the gate through which they would pass into the sensorimotor areas to find expression in the motor system and in disturbance of organic function. When, through the inhibition of the will, the mind no longer intervenes between the mental impressions and the expression of them, the result is those automatic and uncontrollable acts which we call reflex. Such are many of the acts of the nervous patient, involuntary movements, manifestations of the emotions, and the keen interpretation and realization of sensations and ideas over which the patient has no control. This loss of equilibrium between the sensations received and the power of resistance which the mind is able to oppose against their spontaneous manifestation constitutes what is called lack of inhibition, which is the burden of the neurasthenic. Unable to resist them he becomes a prey to the dark thoughts which his condition invites, and in this morbid state the loss of voluntary energy or resistance is the gravest obstacle in the way of recovery. The first object, therefore, is to restore this power, so that the mind will be enabled to react against these depressing influences and thus begin to regain its equilibrium. Systematic and intelligent purposeful exercise is an important means to this end from the simple fact that such muscular effort is impossible without some effort of the will, and the will, like the body, develops by use. This purpose should be kept constantly in mind in deciding upon the form of exercise to be tried in each case, with the view of making the strongest appeal to the will of the patient. And this should be applied carefully at first so as to overtax neither the body nor the mind, then gradually increased as the patient gains endurance and resistance.

The safest test in the selection and insistance on certain kinds of exercise is the effect that they have, not the effect that the patient says they have. If exercise tends to make him accept the enforced rest and isolation more gracefully, to increase the appetite and facilitate the action of the bowels, to promote a feeling of relaxation and sleep—then it is beneficial and should be continued, increased, and varied. If, however, it has the opposite effect, it should be curtailed or entirely stopped for a time and rest rigorously enforced, while the exercise necessary to

promote tissue metamorphosis is got by passive movements. It is often well for a patient who is isolated and who is taking a moderate rest cure to indulge in certain occupations which help to pass the time and to distract the mind. Women should be encouraged to sew, to knit, and to play cards, while men should be allowed to play billiards, backgammon, and the like, providing these are not looked upon as tasks and do not cause fatigue. Recovery can often be much expedited by encouraging the patient to indulge moderately in some occupation suitable to his strength and talents. If this occupation results in the production of something tangible and useful so much the better.

Exercise in the open air, particularly when it holds the interest, is of decided benefit to those whose neurasthenia is apparently the result of sedentary work, absorbing mental occupation, worry, care, and anxiety. It is also very necessary for those who have the uric-acid diathesis and tendency to catarrhal condition of the bowels. In the forms characterized by anxiety, vasomotor manifestations, and profound myasthenia, and in some cases with conspicuous disturbance of the sexual sphere, it is not so valuable.

Massage is often overrated as a therapeutic aid in the treatment of neurasthenia, and perhaps sometimes underrated. It is needless to say that it has no specific virtue. Like all physical agencies that are useful in the treatment of this disease, it owes its good effects to the aid which it gives to processes of metabolism, and to the appeal which it makes to the mind of the sufferer. The latter overshadows the former. Massage is therefore oftentimes more beneficial when it is given according to a complicated system, in which all the details are strictly carried out, and when it is given with complicated mechanical apparatus. The usefulness of abdominal massage in overcoming constipation has already been mentioned. No definite rules can be given for the use of massage, for so much depends upon the person and upon the type of his disease. Some patients, particularly men and those with anxiety type of the neurosis, do not tolerate it at all; while others, women, depressed neurasthenics, and fat individuals, enjoy it and frequently sleep after a séance. Massage operators say that the efficacy of massage depends largely upon the manner of giving it and the system with which it is carried out. Their view of the matter is an interested and a biassed one. It may be used advantageously to overcome constipation, stiffness and soreness of the joints and extremities, tenderness of the muscles, and myasthenia. Insomnia can sometimes be combated by vigorous massage of the entire body for an hour or more just before retiring, or by downward stroking of the sides and back of the neck. This procedure seems to influence the intracranial circulation by facilitating the flow of blood in the veins.

Climatotherapy.—The influence of climate in the treatment of neurasthenia is not very great. The neurasthenic patient recovers more

quickly in a climate that allows him to spend comfortably a portion of the time in the open air, and to have plenty of this important element in a pure state in his living apartment. A climate that is so moist and warm that it tends to general enervation, or one that is so cold and dry that a great deal of energy is needed to withstand it, is contraindicated. The advantage in change of climate is more often due to the new environment, with its freedom from strife and distressing annoyances, and the attention to diet, rest, exercise, and hygienic rules which it entails, than to climatic conditions. A stay in the hills or mountains for those on whom the seaside or plain palls on account of long association is best, and vice versa for the same reasons. The influence of beautiful scenery, inspiring surroundings, and the wonders of nature may impress upon the self-centred patient how trivial and uninteresting he is when compared with it all, and help to lift him out of himself. Like everything else in the treatment of neurasthenia, very much depends upon the individual.

The question of travel for neurasthenic patients is not a very difficult one to decide. For the many it is impracticable, and the few are better off without it. For one neurasthenic patient who is benefited by aimless "travelling for health" ten are injured by it.

Drugs in the Treatment of Neurasthenia.—The medicinal treatment of neurasthenia is the least important duty of the physician, though it is often difficult to convince the patient of this, and physicians as well. Despite the reams of paper that have been consumed in disseminating the information that "spermin," "nuclein," animal extracts, and emulsions of nerve substance are specifics in the treatment of neurasthenia, it is palpably evident that none of these substances has advanced the therapy of the affection a particle. Symptom medicines are invaluable to meet certain indications, and disease medicines assist in overcoming certain organic conditions, such as anæmia; but, despite this, the majority of neurasthenic patients would reach the goal of recovery just as surely and quickly if drugs were entirely discarded. At least it may be truthfully said that it is often as important to forbid the patient all medicine as it is to prescribe it. Neurologists will probably agree that the majority of neurasthenic patients that come to them after having been treated by their family physician or desultorily by a number of physicians, are so thoroughly bromidized that this state demands treatment. I do not mean to say that the bromine salts are not often of signal use to relieve certain distressing symptoms, such as head pressure, palpitation of the heart, and abdominal fluttering; but they should never be given continuously, promiscuously, or without special indication.

Although the pharmacopœia contains no drug that has special virtue to "strengthen" the nervous system or to restore its equilibrium when the balance is once disturbed, still there are certain drugs which create an appetite, aid digestion and assimilation, force oxidation and elimination, and add

to the constituents of the blood and are therefore useful when such indications exist. The simple bitters and stomachics, given for a short time, will be pretty sure to cause greater relish for food. Arsenic, nux vomica, and quinine often not only increase the appetite, but seem to have a general tonifying effect, particularly upon the muscular system. Cod-liver oil, which is supposed to be of special service in the treatment of neurasthenia, has no other virtue than to provide an easily digested carbonaceous food. In anæmic persons suitable preparations of iron and arsenic, alternated or combined with the simple bitters, must be given. In giving iron it should not be forgotten that it has been proven by experiment that the quantity which the blood will take up stands in no relationship to the amount given. Not infrequently good effects follow repeated inhalation of oxygen. It not only gives a general fillip to the system but it has a desirable mental effect. In the use of arsenic and quinine it is well to bear in mind that the former has a tendency to cause disturbance of the stomach and intestines, which may be very distressing to the patient and tend to make him more self-centred; while the latter, if given in other than very small doses, is sure to cause ringing in the ears and vertigo, which he will be likely to interpret as most disastrous manifestations. The administration of aphrodisiacs in sexual neurasthenia is conceived in error, and should never be tried except for the mental effects. Drugs that make powerful appeal to the mind by insulting one of the special senses—such as valerian, for example, particularly when given with assurance that it will be beneficial—are often of great comfort to the patient, and thereby useful. Hypnotics are rarely necessary when rest and exercise, hydrotherapy, and massage are properly and faithfully used. It is often necessary to give one of the simpler hypnotics a few times, in order to secure sleep, until the physical measures just mentioned have time to take effect. They should be given in large enough doses to make them effective, so that the patient may be impressed that a remedy is at hand which can easily cope with the insomnia.

Local Treatment.—Reference has already been made to the absurdity of depending upon local treatment alone to cure neurasthenia, whether such treatment be directed to the prostate, the eye muscles, the uterus, or the stomach. All of these organs are very likely to show considerable disorder of function in neurasthenia, but so does every other tissue or organ of the body in varying degree. They all need treatment, and thus it is that hydriatics, diet, rest and exercise, etc., have proven to be the really trustworthy therapeutic agencies. Occasionally neurasthenia occurs with or follows rectal abscesses and fistula, enlarged prostate, a sluggish or even inflamed condition of the seminal vesicles and excessive use of ill-balanced eye muscles. In every such case the effort should be made to rid the patient of these evident infirmities. This is tantamount to saying that the causal treatment of neurasthenia should never be neglected.

If such treatment suffices, the patient and the physician have good cause for mutual congratulation. Unfortunately, however, it does not suffice in about ninety per cent of the cases, and it is unwise to neglect the ninety merely to reach the ten. The picture is more enticing when reversed.

The Plan.—From all that has been said it will be granted that the physician himself is of first importance in the treatment of this neurosis. His success in handling neurasthenia will stand in direct proportion to his power to inspire and hold the confidence of the patient, and the thoroughness and persistence with which he makes use of the physical measures that have been detailed, for improvement of the general nutrition of the body and mind. To carry such treatment to successful issue requires great individualization, stalwart confidence, tact, perseverance, and, above all, strict personal attention to detail. The physician should continually strive to lift his patient from the quagmire of dread, despair, and despondency into which he has been hurled by this dreadful infirmity, and implant in its stead sentiments of hope, confidence, and courage. As a rule, it may be said that a patient with neurasthenia should be examined and treated with the same attention to detail as one with typhoid fever or endocarditis. The fact that careful examination and methodical treatment effect a cure, in part or largely through their appeal to the mind of the patient, in no way detracts from them as tangible therapeutic measures. On the contrary, that is all the more reason for their use. The more often they are employed the less frequent will be the reports of cures by Christian scientists, faith curists, negro hoodoos, osteopaths, incantation men, and other fakirs and mystery mongers.

The physician who has neither the time nor the inclination to devote such care and attention to the neurasthenic patient should have the frankness and moral courage to say so, and not keep the patient on by promises of recovery which he cannot back up with results; while the physician who feels that he is discharging his duty by telling the patient that his sufferings are "imaginary," "mental," "trifling," can scarcely be said to have the modern conception of this neurosis, and is therefore not fitted to deal with it. As the plan of treatment is so important in neurasthenia, the physician and the patient will have to decide whether it is feasible to carry it out at home. If it is not entirely so, it had better not be attempted, as each failure lessens the patient's chance of speedy recovery. No compromise should be made with the patient or with the family in the matter of conformation to instructions. If he is unwilling to do all that the physician assures him is necessary, he will soon come to view the matter in a different light when told that the treatment of his case cannot otherwise be undertaken. Occasionally it will be necessary to avail one's self of the facilities of commercial sanatoria

which are fully equipped with hydriatic and mechanical devices for the use of water, massage, and passive exercise. There is much to be said against and but little in favor of such institutions. As a general rule, it may be said that institutional treatment is opposed to individualization, and should rarely be recommended.

CHAPTER XXVIII.

THE TREATMENT OF HYSTERIA.

Hysteria is a psycho-neurosis, characterized by disorder of the will, perversion of the inhibitory powers of consciousness, and by partial cessation or exaltation of individual functions of the brain. A disease that is thus characterized must necessarily be attended in its clinical course by a great variety of symptoms. It is this variety and diversity of symptoms, commonly called protean, that distinguishes it from all other nervous or mental diseases. The ancient conception of the disease made hysteria an attribute of the reproductive organs and restricted its occurrence to the female; a more modern one looked upon it as a contemptible shortcoming, and placed it in the category of conceit, affectation, and other attributes of puerility and of incomplete development. The most modern view considers it a psycho-neurosis, and associates its genesis with profound neuropathic or psychopathic heritage as a predisposing cause, and with psychical trauma, and all things contributing to it, as the most important exciting cause.

Etiology.—Aside from what has just been said, little is known of the etiology of hysteria. It occurs most often in women during the period of their fecundity, but it is by no means rare in children and in males of almost any age. When the disease occurs in men its manifestations are likely to be more severe than in women. The profounder forms of the disease are relatively uncommon in this country. This contrasts very strikingly with its frequency in the Latin countries and in those immediately adjoining such as Austria and Switzerland. In its minor forms, it is not so uncommon in the Anglo-Saxon race wherever they have emigrated, and the manifestations of it are not infrequent in their literature, art, and politics, and sometimes even in their religion. The histories of witchcraft in New England, and of fanatic religious revivals and practices in the South and West of our country give ample proof that the most profound forms of hysteria have occurred in this country from the time of its civilization. In later years, it is a relatively common disorder in hospital as well as in private practice of our large cities. This is due to the enormous influx of the Jewish race, whose members are particularly prone to the manifestations of this as well as all other hereditary, degenerative, nervous diseases.

Hysterical individuals are degenerates, but a larger number belong in the category of superior degenerates than of inferior degenerates. Ge-

nerically, the disease is closely allied to neurasthenia and hypochondriasis, especially the forms of these neuroses that are not entirely acquired. Hysteria is rarely, if ever, purely an acquired neurosis. Although there are a number of factors which seem to play an important rôle in the immediate occurrence of hysteria, these agencies could not cause the phenomena of the disease were it not for the inherited psychopathic predisposition. The causes of the neuropathic and psychopathic disposition have been considered in Part I. The most important of the provocative agencies are unquestionably mental and moral traumata. Physical injury also plays a very conspicuous part, but its injuriousness is in direct relationship to the psychical injury, be it pain, fright, or anxiety, with which it is accompanied. In the same way is to be explained the apparent capacity for mischief of masturbation and comparatively slight sexual excess which play a conspicuous rôle in the etiology of some cases. It is not the depreciation of nutrition and vigor caused by these which is responsible for the psychopathic condition that develops, but the impression that they make upon the mind of the individual whose suggestibility is pathologically increased. Toxic substances, such as alcohol, tobacco, and those encountered in occupations, as well as some of the acute infections, and syphilis occasionally seem to have a bearing upon the immediate occurrence of hysteria. They do so by depreciating nutrition and by making a profound impression upon the patient's mind. The phenomena of hysteria are often superimposed on those of organic nervous disease such as brain tumor, and general disease such as anæmia. It should not be inferred from this that hysteria always occurs in those whose general nutrition is depraved. On the contrary, the victims of this neurosis are often ruddy and well nourished and apparently vigorous. The provocative agent oftentimes seems incredibly trifling when contrasted with the results that it produces. The profoundest case of major hysteria that I have ever met occurred in a pathologically sensitive lawyer on his failing to be elected counsel to a society which he had previously served.

Symptoms.—The symptoms or phenomena of hysteria are so numerous and varied that it is difficult to portray them in a few lines. They are referable to all of the systems of the body, the most important being the psychical, motor, sensory, and secretory symptoms.

The leading psychical symptoms are weakness of the will power, defective inhibition of mental and emotional externalization, capriciousness, moodiness, irritability, desire to attract attention and to elicit sympathy, and exaggeration in statement and in action.

The symptoms on the side of the motor sphere may be paralytic, spastic, convulsive, or tremulous. These may be revealed in any part of the body whose function it is to cause movement. Hysterical paralysis may be monoplegic, paraplegic, or hemiplegic. The last mentioned is the

rarest form. It is distinguished from the organic variety by non-implication of the face and tongue. Although hysterical paralysis may be flaccid, it is almost invariably associated with contracture. Paralysis of the peripheral vocal apparatus is not uncommon and causes mutism or aphonia. Contracture is the commonest motor symptom of hysteria, the upper extremities being especially liable to affection. It may develop suddenly after an hysterical spasm or slowly with hysterical pain. It disappears when the patient is anæsthetized. Hysterical spasms or convulsions may affect any part of the body. They are usually clonico-tonic but occasionally tonic. Spasm of one-half of the tongue and lips is a not uncommon manifestation.

Hysterical tremor may be rapid or slow, and may parallel tremor of any origin. A comparatively rare motor manifestation of hysteria is astasia-abasia. This is the name given to a condition in which the patient is unable to stand or walk notwithstanding that all movements can be easily done when lying.

The sensory symptoms of hysteria constitute the most important and constant stigmata of the disease. They consist of depression which may amount to absolute loss, or exaltation of the functions of the special senses, and common sensibility. The functional shortcomings of the special senses may show themselves as: 1. Those referable to vision: amblyobia and amaurosis; concentric limitations of the visual field, especially marked for colors; achromatopsia, and various manifestations of micropsia and megalopsia. 2. Those referable to smell: partial or complete anosmia associated with anæsthesia of the nasal mucous membrane. 3. Those referable to taste: ageusia. 4. Those referable to hearing: a varying degree of deafness, especially for high notes. The perversions of common sensibility which occur in hysteria are irregularly distributed areas of anæsthesia and analgesia, and hyperæsthesia and hyperalgesia. Hemianæsthesia may be of an entire half of the body or of a small area. It is the result of a loss of association of impressions conveyed to consciousness. Hyperæsthesia may be of one-half of the body or of only a small segment of the cutaneous surface. It is manifest by excessive sensitiveness. It is apt to have zonal distribution: hysterogenic zones, pressure on which will often cause an hysterical attack.

The subjective sensory phenomena of hysteria are also referable to the various special senses and consist of flashes of light, noises in the ears, strange tastes and smells, tingling and formication of the extremities and trunk, a feeling of constriction and of a lump in the throat, known as globus hystericus, and peculiar boring pain in the top of the head known as clavus hystericus. Pains of every kind and of any location are also often present in hysteria.

Vasomotor disturbances of hysteria consist of dermographism, cyanosis, and œdema, the latter of a peculiar variety known as blue œdema,

swelling of the joints constituting hysterical arthropathy, and hemorrhages from the skin and mucous membranes.

The cutaneous reflexes are usually diminished or absent, while the deep reflexes are not infrequently normal. It would seem to have been definitely proven that not only may exaggeration of the deep reflexes occur with hysteria, but true clonus as well.

The vegetative processes of the body are often enormously perverted in their functions. Disturbances in the digestive tract may show themselves as anorexia, spasm of the œsophagus, vomiting, indigestion (so-called nervous dyspepsia), borborygmus, meteorismus and abdominal distention constituting pseudo-cyesis. Symptoms of hysteria referable to the respiratory system may be manifest as spasm of the larynx, dyspnœa, tachypnœa, spasmodic cough, and hiccough. The most common hysterical symptoms referable to the cardiac system are palpitation, tachycardia, and pseudoangina. Those referable to the urinary system are anuria and polyuria, and to the cutaneous system excessive and diminished secretion of sweat.

Grand or major hysteria manifests itself irregularly in attacks known as hysterical convulsions. These are irritation symptoms of central origin which appear in various forms and combinations. They consist of clonic and clonico-tonic convulsions of the extremities and body, which produce in a wild manner the most bizarre positions of the body, constituting clownism, arc de cercle, trismus, convulsive movements of laughing, crying, swallowing, and breathing. Attacks of grand hysteria are usually divided into three stages, the first stage consisting of epileptiform twitchings or spasms, the second stage of gross movements, and the third stage of passionate attitudes and plastic positions.

The treatment of hysteria will be considered under four headings: first, the prophylactic treatment; second, the treatment of the disease itself or treatment of the psychopathic state; third, the treatment of an attack; and fourth, the treatment of individual manifestations.

Prophylactic Treatment.—Like all nervous diseases developing on a neuropathic or psychopathic state, the treatment of this psychoneurosis should be begun before the birth of the child who is heir to it; that is, it should be begun before conception. Hysterical parents owe it to their children that their mode of life shall conform to a plan that contributes to the highest degree of physical and mental equilibrium. They should be instructed to avoid conception at times when there are any manifestations of disorder in neural equilibrium. The necessity of the proper direction of an hysterical woman's life during pregnancy cannot be too strongly urged upon physicians who have the care of families. The end to be kept in view is to maintain an uneventful course of her mental life during this period in order that she may bring forth a child with a stable nervous organization. This can in a measure be aided by studiously

arranging her environment so that everything is in evidence that makes for mental equanimity and self-restraint. Pampering of vicious tastes, self-indulgence, all forms of excitement, particularly those that appeal to the emotions, sources of fear and worry and physical injury are to be avoided.

The children of hysterical parents should be removed from the care and espionage of the family, especially if the mother is hysterical, as soon as possible after the actual formative stage of the child's character, that is, from the sixth to the tenth year. This is especially incumbent when the child shows such evidences of an unstable nervous system as night terrors, disordered sleep, marked erethism without apparent cause, abnormal sensitiveness, restlessness, destructiveness, precocity, and manifest desire to elicit the sympathy or wonderment of those about it. Such a plan contributes not alone to the welfare of the parent, but is highly important to the child. A child who at this period is allowed to see the various manifestations of hysteria in the mother, be they explosions of temper, uncontrollable emotional display, convulsions, or other terrorizing symptoms of the disease, will be almost sure to develop similar manifestations sooner or later if allowed to remain in such environment. Naturally, it is oftentimes impossible because of social and financial reasons to take the child from such auspices, pernicious though they are. In such cases the best compromise must be made, so that the child is kept as much as possible from the sinister influence of the hysterical person at the time of the attacks. When no other reason than one of sentiment is given for refusing to permit the child to be taken from the influence of an hysterical parent, the physician should use all his tact, persuasiveness, and authority to carry out the plan proposed. So much misery and suffering may thus be spared that the end justifies rather drastic measures.

When such children are taken from their parents in order that their education and bringing up may be carried out under more rigorous and favorable surroundings, the intelligent teacher and caretaker to whom they are entrusted must be fully told of the desired objects in the formation of their characters. The education of children of hysterical parentage calls for the same intelligent co-operation of physician and pedagogue as does that of defective children. Their combined efforts should be to develop and maintain a high degree of bodily strength, vigor, and nutrition. No attempt should be made to force the development of the mind by thrusting upon it inconsiderately the various components of modern education and modern accomplishments. All manifestations of precociousness, mental, sexual, and moral, should be discouraged; childish coquetry, self-indulgence, and excessive sensitiveness exterminated; romantic sentiments and disquieting imagery banished; and puerile love attachments and associations absolutely forbidden. The epochal periods of menstruation in the girl and of maturity in the boy are to be jealously

guarded. Not a few cases of hysteria have been provoked by fright, shame, or conviction of the necessity for concealment of the occurrence of these normal functions in those who have not been carefully and properly warned of their advent.

The trend of modishness in this country happily is toward the development of the body by encouraging out-of-door sports for both sexes. Physical prodigies are nowadays very much more in evidence as display children and youth than the wonder child and intellectual marvel of a generation ago. Indulgence in such sports for children, abundance of refreshing sleep in well-ventilated rooms, and total interdiction of tea, coffee, alcohol, and stories of the bogieman are inimical to the development of hysteria. Inculcation of the precepts of self-control, generous feeling, altruistic sentiment, and intolerance of mawkish sympathy, childish jealousy and puerile introspectiveness do much to stay the hysterical tendency. The psychical traumata which start the dynamic defects of hysteria into existence are not infrequently traced to sentimental love affairs which the modern girl is often permitted to take seriously, and to the separation that parents awakening to their responsibilities feel obliged to make, and which she considers violent and unjustified. Later in life, it is sometimes synonymous with the fright and plight associated with the assumption of marital obligations by persons totally unfit, and to abnormal sexual indulgences such as coitus reservatus, and artificial prevention of pregnancy. Still later in life, it sometimes occurs at the period of the menopause without any provocative agency which can be detected. In these latter cases there are no special indications for prophylactic treatment save in those instances in which the neuropathic person has safely reached the period when the menopause is to be expected; then particular care should be taken to carry her through this eventful period without unusual demands being made upon mind or body.

The Treatment of the Disease Itself or the Psychopathic State.—The general treatment of the psychopathic state, the basis of hysteria, must be conducted on the plan that the disease, although strictly a psychical one, may nevertheless be very much influenced in its manifestations by physical conditions. Very often the measures necessary successfully to combat the collective manifestations that constitute the state hysteria must be applied hand-in-hand with those taken for the relief of some one symptom or stigma of hysteria, such as contracture, paralysis, hemianæsthesia, or blunting and obscuration of some special sense. But, on the other hand, not infrequently one or more of these stigmata is the sole manifestation of the disease. The mistake has often been made by writers of giving entirely too much attention to a consideration of the specific hysterical symptom or stigma because the general psychical condition of the patient seemed to be quite unaffected. It should not be forgotten that such manifestations as so-called hysterical stigmata are

only an expression of the general psychopathic abnormality, and that this state calls for treatment just as urgently as do the individual phenomena.

The first and most important step in the treatment of an hysterical patient is for the physician to put himself entirely *en rapport* with the patient and completely in authority with the family of the patient. That is, he should secure the confidence of the former and the obedience and co-operation of the latter. Nothing is more deleterious to the prospects of overcoming the manifestations of hysteria than to attempt to make light of the occurrences, as being merely trivial, unless it be to magnify the symptoms in such a way that the patient will not only become more self-centred and indulgent, but that she may have a lien upon those surrounding her, be they of the family or attendants. Often it is necessary to undo the work of charlatans and scientific impostors who have attempted to cure the disease in some bizarre or supernatural manner, and thereby succeeded in making the patient more invulnerable to the righteous and authoritative influence which the honest physician should have. As the treatment is mainly psychical, even though a great variety of physical agencies are used, the plan of treatment should be so arranged that every step taken should count in a forward direction. Some writers, whose knowledge of the clinical history of hysteria is seemingly based on very slight personal experience, try to maintain that a detailed plan of treatment defeats its own object by centring the patient upon his or her own ailments. This is an entirely erroneous view, providing the details of treatment exclude everything that partakes of coddling. Another mistake that the physician should try to avoid is promising the patient results that he cannot be at least moderately sure of securing, for in no way can the patient's confidence be more thoroughly shattered than by disappointment. The ultimate object in the treatment of an hysterical patient should be to develop the patient's will, so that it will regain the dominancy over mental possessions and compulsions.

The general dietetic and physical treatment is not unlike that of neurasthenia. Greater individualization in the details of treatment is necessary in the treatment of hysteria than in almost any other nervous disease. It need scarcely be said that there is no specific medication. In the severer forms of the disease a most important disciplinary and hygienic measure, as well as one that contributes to a rehabilitation of the general nutrition, is complete or relative isolation. The patient, as well as the family, is apt to look upon this measure as an unnecessary cruelty directed against one who has been able to exist only because of the tender care and continuous sympathy that have been lavished upon him or her. Even in the milder forms of hysteria—and by this I mean any hysterical manifestations short of grand or major hysteria and the clinical conditions unfortunately called hystero-epilepsy and hystero-

catalepsy, it often becomes absolutely necessary to separate the patient from the previous social and family environment. In this way, not only will the comparatively mild manifestations of the disease be surely overcome, but the psychoneurosis will be prevented from getting a firm and undislodgable hold upon the patient. In many instances this isolation must be carried out in the patient's home; but whenever feasible, it is best accomplished away from home in a boarding-house or hotel where the patient can be under the physician's direct supervision and alone with the nurse to whom he entrusts her care. Institution treatment, and particularly that of large sanatoria, cannot be recommended, except in instances in which special provision is made for the complete isolation and individual treatment of the patient. The routine treatment of such institutions and the atmosphere of invalidism which they necessarily have, not to speak of the arena which they offer for the exchange of emotional commodities, render them extremely antipodal to the overcoming of the hysterical state and its manifestations. In latter years there has been a decided inclination on the part of some physicians to insist upon institution treatment for hysterical patients, at least of patients whose symptoms do not yield to more or less desultory and routine treatment. This idea has been borrowed in a measure from European practice. In Germany, for instance, it is no uncommon thing for a patient to go to a sanatorium of some kind before he consults a physician. Institution treatment is undoubtedly better than treatment at home, but best of all is the complete isolation of the patient. As has been said, the patient and family usually offer great objections to this. The moral victory of getting a patient isolated is very important, and often it is the first decisive step in the psychical treatment of the disease.

The psychical or mental treatment of hysteria is spoken of as if it were some formula to be applied in a rather definite way. This is not the sense in which I desire to be understood. It is quite impossible to put in words what constitutes psychical treatment. It not only means the attitude of the physician toward his patient, including his capacity to inspire such faith that the patient's defective will power will be stimulated to action, and the plan of isolation with its entailments already spoken of, but it embraces as well the proper application of such mechanical therapy as water, electricity, massage, exercise and occupation. These, although they have specific beneficial action by virtue of individual possessions, often accomplish more through the mental impression that they make than through their specific effects. The immediate results attending the use of many of them serve to inspire and inspirit the patients. It is admitted by every one that these measures are often effective in increasing the patient's nutrition and vitality. Hysterical patients are often anæmic, with sluggish circulation, faulty digestion and excretion, all of which are important factors in maintaining the hys-

terical state; therefore, these must be amended as soon and as thoroughly as possible.

The most important of the mechanical measures in the treatment of hysteria is undoubtedly hydrotherapy. The general plan of hydric procedure in this disease is very much the same as that for neurasthenia. The details of application vary with the type of disease and with the idiosyncrasies of the patient. The most important methods of applying water in hysteria are by the douche and spray, by the drip sheet, and by ablutions or the plunge. Cold water is the most potent agency to stimulate the circulation and to facilitate metabolic changes that are necessary for the preservation of normal nutrition. It has likewise a powerful effect as a sedative on the sensory nerves of the skin, and as there is frequently in hysteria not only a peripheral but a central hyperæsthesia, some of the beneficial results of the application of cold water in hysteria may be attributed to the sedation which is one of its most conspicuous after-effects. Indeed, the two purposes that hydric procedure is intended to subserve in the treatment of hysteria are tonic and sedative. The tonic effect of cold water, as has already been pointed out in the chapter on hydrotherapy, is coequivalent with the reaction that follows the application of water. Therefore, it behooves the physician to observe closely how complete this reaction is in each patient, and to employ the means for facilitating reaction which are described on page 65 *et seq.*

Of all the hydric procedures, the most important in hysteria is the tonic bath, which may be given beneficially in this disease at a much lower temperature than in neurasthenia. For instance, in neurasthenia it is usually advisable to begin a course of hydric treatment with a temperature of 85° F.; while in hysteria, if the patient has no profound depravity of the vascular system, the douche may be used in the beginning at a temperature of from 60° to 55° F. Indeed, in some cases that are rebellious to treatment the most satisfactory results follow the application of a douche of from 40° to 45° F., under from fifteen to twenty pounds pressure for five or six seconds, followed by a Fleury spray of 80° and similar pressure from one or two seconds. It should not be forgotten that the lower the temperature of the water the shorter should be the time of its application. And as the reaction is usually very much better when the douche is applied for a very few seconds, it is the most satisfactory procedure. It is necessary to say one word of warning concerning its use. The dashing of cold water upon hysterogenic zones may precipitate an attack of hysteria. This can be avoided by a search for such areas before the water is applied, and then if the douche is directed toward them at all, it should be under very much lessened pressure than on other parts of the body. In some patients reaction will be accompanied by headache and frontal fulness, vertigo, great lassitude, cold extremities, etc. All of these can and should be avoided. To prevent the headache

and fulness, all that is necessary usually is to have the patient's head enclosed in a towel wrung out of iced water, and to stand the patient in a foot-tub of hot water during the application of the douche. Similar results can be obtained by vigorous percussion and slapping of the feet after the douche or by directing a stream of hot water against them for two or three seconds. If the patient complains of distressing sensation of fulness in the chest and of palpitation, a cold compress should be placed over the precordium during the application of the douche. It has been my experience that this feeling is more likely to occur in those who take the tonic bath soon after a considerable meal, such as lunch. It may therefore be said in this connection that the best time for any tonic hydric procedure is in the forenoon, from one-half to two hours after the patient has had a light breakfast. At the end of the half-hour or so following the bath, which is taken up in walking; gymnastics, or passive exercise to facilitate reaction, depending upon the one that the patient is able to take, substantial nourishment should be given.

When, for any reason, the douche and spray constituting the tonic bath do not seem to be well borne, or when their application is not followed by the desired benefit, the Scottish douche may be tried. In hysteria the best results from this procedure are obtained when the douche is used with cold water, and not with sudden thermal transitions, such as are used in cases of sciatica and neurasthenia. The stream of water of from 95° to 105° F., depending upon the tolerance of the patient, is directed against the various parts of the body for from one to two seconds, then the temperature is lowered 15° to 25° F., not too abruptly, and the stream is kept up for from five to fifteen seconds. When the Scotch douche with transition is used, the temperature is lowered very gradually, so that the element of shock which enters into the ordinary use of it is not operative. When the patient is very sensitive, and when there are areas of profound hyperæsthesia of the skin, it is often advisable to begin with this procedure, and gradually lead up to the use of the douche without transition, or the tonic bath.

It may seem to the reader that considerable paraphernalia are necessary in order to carry out such details of treatment as that indicated in the tonic bath and the Scotch douche. As a matter of fact, this is not so. Wherever sufficient pressure can be obtained, it is comparatively easy to supply the rest. All that is really needed is a tub and a piece of hose pipe with a detachable spray, the so-called Fleury spray, and the Scottish douche, which, of course, is more complicated. When it is possible, the physician should avail himself of a properly equipped hydriatic institution. Even here it is necessary to give each case personal supervision at first, because no two patients react alike to the application of water. When it is impossible to use water in either of the ways that have been described, the wet sheet or drip sheet, as it is often called,

should be tried. While the patient stands on a dry surface, a sheet wrung out of water of from 45° to 50° should be thrown around the patient so that it envelops him from his neck to his feet, the face, head, and chest, perhaps the entire trunk having been previously moistened with water of the same temperature applied by the hand or a sponge. After the sheet has been thrown around the patient, he should rub the chest and front of the body vigorously through a fold of the sheet, while the person who is applying the sheet does the same with the palms of both hands over the sheet, to the posterior parts of the body. This friction is kept up for from three to five minutes until the skin gets well reddened, when the sheet is removed and a second dry one is substituted for it. Friction in a similar way is then kept up for a few minutes longer, and the patient is told to dress quickly and go for a brisk walk. Insufficient reaction and disagreeable after-phenomena are overcome by use of the measures intended to meet such conditions occurring after the tonic bath. The cold plunge bath, when the patient's circulation will allow of its use, is an excellent general tonic. It should not be forgotten, however, that it is necessary for the patient to have a few minutes of physical activity before entering the tub and active friction while in the water and after getting out, in order to insure thorough reaction.

Electricity is another agency of very considerable value in the treatment of hysteria. Like water, it acts upon the body and upon the mind to improve the nutrition of the former and to make a powerful impression upon the latter. The form of electricity that is most useful in this psychopathic state is best decided after trial. As a rule, it is either faradic or static electricity. Faradic electricity is an important agency in soothing the sensory nerves, and when employed in the shape of a faradic brush, it is a potent measure to overcome hysterical anæsthesia. Static electricity is often frowned at nowadays, as it plays such a conspicuous part in the armamentarium of the charlatan, but it must be conceded that it frequently has not only a commendable moral effect, but acts as a powerful tonic to the muscular and nervous systems as well. In fact, its action is not unlike that of another therapeutic procedure which has come somewhat into vogue again, viz., rapidly repeated and multiple percussion, as advocated by Granville. This form of electric energy has the same characteristics as the faradic, viz., high tension and slight quantity. It should be given by means of the ball electrodes to the body and by the coronal brush electrode to the head in séances of from ten to fifteen minutes daily. It is not so useful in erethistic and painful states as faradic electricity of the long coil and rapid vibration. Galvanic electricity is of no service in hysteria, except to overcome some of the trophic conditions, such as muscular atrophy and œdema, two symptoms of not very common occurrence in this disease.

Massage, Swedish movements, calisthenics, are often beneficially used to combat manifestations of asthenia, to increase muscular tone, and to overcome hysterical paralyses and atrophy, particularly while the patient is undergoing isolation treatment. The various forms of outdoor exercise, such as golfing, bicycling, and horseback riding—which are so often serviceable not only to improve the patient's general condition, but to teach him self-reliance and to make him less indulgent and introspective—all may be made to play a very important part to prevent hysterical paroxysms, and to assist in recovering from them. When there are no special indications to the contrary, the life of an hysterical patient should be one of physical activity. Naturally, such an arrangement is not incompatible with the discipline of isolation.

The medicinal treatment of the psychoneurosis hysteria does not call for very extended discussion, for the truth is that there are no indications for medicinal treatment, save to meet certain special indications. Unfortunately, the salts of bromine are very extensively used by the general practitioner as sedative agencies. There are more dangerous and pernicious methods of treating hysteria than this, but they are very few. I do not mean to convey the impression that a few doses of a bromine salt are not frequently indicated to overcome special manifestations of erethism and excitement. It is the routine treatment by bromides of which I particularly speak. The administration of foul-smelling, pungent medicines, such as the valerianate of zinc, and tincture of valerian, is the legacy of a barbarous pharmacology. They are of slight service because of their powerful odor, which makes an impression upon the imagination, but they are not so useful in this direction as pills made from methylene blue, which, giving a decided color to the urine, makes an enormous impression upon the patient. In most cases it is necessary to give some medicines, and it is better to give those that can act by suggestion than to give those that do not act at all. I have often been convinced of the value in warding off an attack of a capsule containing valerian and compound spirits of ether, taken when the patient had premonitions which were indicative to her of the onset of an attack.

The regulation of the various functions of the body, such as that of the bowels, the kidneys, the reproductive organs, and skin, requires no other mention save to say that careful consideration of them will be amply rewarded in the treatment of this disease, as it is in every other in which there is a lack of balance between the production and the expenditure of energy. Restoratives, such as iron and cod-liver oil, appetizers in the shape of the simple bitters, and occasionally sedatives, particularly those acting on the sympathetic nervous system, have an important place in the therapy of hysteria.

It is necessary to say a word concerning the surgical procedures, particularly on the generative organs, that have been proposed in the treat-

ment of hysteria. These operations are oöphorectomy or the removal of the normal ovaries, hysterectomy, clitoridectomy, and castration in the male. No mention is made of operations on the nose, the coccyx, the vagina, etc., because these are insignificant compared with those first mentioned. The time is happily gone by when such operations were commonly performed, although one can still hear the indications for their use discussed now and then in medical societies. If there is any one specialist more than another whose aid and counsel should not be sought in the treatment of hysteria, it is the gynæcologist. It seems an unnecessary platitude to say that hysterical women are as liable to uterine disorder as non-hysterical women; but they are not more so, except in so far as the asthenia oftentimes associated with hysteria may predispose to slight displacement or disturbance of function. When such uterine disturbance occurs, naturally, measures should be taken to overcome it; but in no case should there be any treatment from a gynæcologico-neurological standpoint, or any concerted action of the neurologist and the gynæcologist. The same punishment should be meted out to the man who wilfully removes a normal uterus, ovary, or testicle, or one not so far diseased that it cannot be nursed back to a normal condition, as is judiciously given to him who premeditatively takes deliberate aim and maims with weapon of any sort a fellow-creature. In the light of a comprehensive knowledge of reports of cases of hysteria and of hystero-epilepsy cured by surgical procedure upon the generative organs, I say that I refuse to believe that one example of true hysteria has ever been cured by such barbarous, unscientific, unrighteous measures.

The place which hypnotism holds in the therapy of hysteria has always been and will probably always remain an insignificant one, using the term in the only sense in which the majority of the profession, in common with the laity, will use it, viz., that of carrying a person into an unconscious state by means of impressions made on that individual's mind through the medium of one or more of his special senses. This should not be construed to mean that suggestion, whether by word of mouth, by precept, or by ocular demonstration, may not be used advantageously, both to overcome the stigmata of hysteria and to assist in counteracting the general psychopathic condition. Oftentimes such procedures are attended by brilliant and striking results, as, for instance, the disappearance of hysterical pain or hysterical blindness through suggestion. I could record a number of examples of hysterical tremor and palsy that succumbed to a few minutes of suggestive therapy. It has been pointed out in the chapter on psychotherapy that suggestion is much more potent when the patient is in an hypnotic condition, and no objections can be brought forward to show that the procedure known as hypnosis should not be indulged in. The physician who attempts to surround the process with an air of mystery or to flaunt it as an individual

and unusual possession places himself on a plane with the charlatan and negro hoodoo. It is far better to avoid the use of hypnotism entirely as a definite procedure than to abuse it by borrowing the airs of a professional hypnotist. Unquestionably, just as much good could be accomplished in the treatment of hysteria if physicians the world over were to agree never to mention or apply it again.

The Treatment of an Hysterical Attack.—By hysterical attacks is meant transitional states between the ordinary mental condition in hysteria and a genuine hysterical psychosis. In reality they consist of more or less brief states of limitation or disturbance of consciousness associated with profound inhibition of the will. Such states are attended by very different external manifestations, such as spasmodic and convulsive movements in different parts of the body, perhaps affecting all the extremities, taking most often the form of affectation movements. Such are the convulsive laughter and crying; the gestures and positions of fear; and anxiety, sexual excitement, and their emotional accompaniments. In the less severe attacks the external manifestations may be revealed by tremor of the extremities, tonic spasms of the hands or of the face, neck, and shoulders, opisthotonos, jerky and spasmodic respiration. In very severe hysterical attacks, grande hystérie of the French, the convulsive, spasmodic, and affectation movements are most profound. The patient bounds about on the floor, resting only on the heels and back of the head, or she assumes positions of extreme ecstasy or of violent passion, while the mental conditions manifest by all degrees of incoherency up to profoundest delirium keep pace with the motor manifestations. The patient may pass into the different cataleptic conditions and the various forms of hysterical sleep and unconsciousness which sometimes closely simulate death.

In the treatment of the hysterical attack, there is rarely need of great haste. I say this notwithstanding the fact that occasionally the continuance of spasm in the respiratory muscles destroys life, because of my observation that the most common proceeding of the physician, when called to a patient in the apparently agonizing condition of an hysterical paroxysm, is to conciliate the family by cutting it short with a hypodermatic injection of morphine. This is as baneful and ill-advised an action as can be easily imagined, and one that should rarely, if ever, be taken. The first duty is to dispense with the aid and presence of sympathizers, busybodies, and other unnecessary element of the gathering which is sure to be about the patient. The physician owes it to himself to assure the family that he stands between the patient and danger, and that although the attack may last for some time, the eventual outcome will be satisfactory. The conduct of the physician should be such that the patient is impressed that he is in authority. In the majority of instances the patient's consciousness will not be so obscured that she is not

aware of what is going on about her. The "bringing to" of hysterical patients is usually a very simple matter. If the patient does not respond to a vigorous command to wake up, while at the same time she is being assisted to her feet, a glass of cold water dashed into the face, a cold douche applied to the back, or irritation of the skin by means of a faradic current, will usually succeed. If the spasmodic attack is very severe, and it cannot be ended by the measures spoken of, the patient should be given a few whiffs of chloroform, and in the transitional period from hysterical disturbance of consciousness to chloroformation she should be commanded to wake up. If the arousal is not complete, it can be furthered by stimulation of the skin. After such patients recover consciousness, they are usually keenly aware of the spectacle and exhibition that they have made, and their feelings must be jealously guarded. The young physician particularly should remember that sternness is efficacious in proportion as it lacks rudeness and all kinds of maltreatment. In young children, bodily chastisement thoroughly carried out has a very legitimate place in the prevention and treatment of hysterical attacks. Happily, it does not lie within the duties of the physician to administer it. In severe hysterical attacks, the patient should be placed so that she cannot hurt herself or do violence to things or persons about her. If there be need, no hesitation should be had in giving chloroform by inhalation, of course in very small quantities, or in the use of artificial measures of restraint, such as the captive sheet, or a strait-jacket. The measures mentioned as efficacious in the minor attacks may be employed. Sometimes they are successful, but in other cases they and all other measures fail to bring the attack to an end. The ease with which hysterical attacks can be terminated by pressing upon certain areas of the body usually hyperæsthetic, such as the ovarian region, the breasts, the small of the back, and other sensitive areas, has been very much overestimated. These areas being hypersensitive, pressure upon them causes a powerful mental stimulus, and undoubtedly this often has a suggestive effect upon the mind. The oftener one succeeds in ending attacks in this way the more readily will subsequent attacks yield to the same treatment.

The Treatment of Hysterical Stigmata.—The hysterical patient oftentimes consults the physician to seek relief for some individual symptom or condition such as paralysis, contracture, tremor, atrophy, œdema, spasmodic cough or hiccough, borborygmus, anorexia, hæmatemesis, aphonia, mutism; pain in some distinct part of the body, such as the heart, the abdomen, or head; hyperæsthesia and other sensory disturbances irregularly distributed or limited to one side of the body, or disturbance in the function of some of the other special senses, such as partial or complete blindness, deafness, loss of the senses of smell and taste. These are known as the stigmata of hysteria, and they in individual or more or less collective occurrence require particular treatment. It is important to

remember, however, that such particular treatment is not in itself sufficient. The general psychoneurosis should likewise be attacked.

One of the most obstinate hysterical accompaniments to overcome is anorexia. The discipline of isolation and the disagreeable features attending forced feeding by a stomach tube and by rectal alimentation are usually sufficient to make the patient determined and willing to take food naturally. The degree of emaciation which hysterical anorexia may lead to (and indeed it may lead to death) is astounding. The reports of fasting girls are heralded by the secular press throughout the civilized world, and they rarely fail to excite great wonder in the readers, while fortifying the notorious individual in her sinister but uncontrollable purpose. Probably no case is so rebellious that it cannot be overcome by the measures spoken of, particularly if the direction of the patient is in the hands of a firm, notoriety-despising physician. No temporizing, no half-way measures should be the rule here.

Hysterical hæmatemesis is another symptom that frequently requires strict methodical and disciplinary treatment. The patient should be put upon an exclusively milk diet and subjected to absolute isolation. Naturally, such treatment can be carried out at home, providing the family are sufficiently amenable to suggestion and the patient be put under the care of a trustworthy nurse. Hysterical salivation, and swallowing sometimes associated with hawking noises and a feeling of spasm in the œsophagus, should be at once subjected to most rigid isolation, for when this condition becomes chronic, it is in my experience the most difficult hysterical manifestation to dislodge. Hysterical ballooning of the abdomen and borborygmus will usually succumb to the application of the faradic current by means of the brush electrode to the abdomen, and the customary hydriatic, mechanical, and disciplinary treatment. When the ballooning of the abdomen is so constant that the patient is convinced of the presence of a new growth or pregnancy, no time should be lost in etherizing or chloroforming her in order to convince the family of the true nature of the symptom and to impress upon the patient the reality of its disappearance under such conditions. Abdominal pain, usually of great intensity and of more or less constancy, although subject to paroxysmal exacerbation, is usually associated with the existence of hysterogenic zones in the region of the ovaries, and these should be overcome by counter-irritation, the application of faradic electricity, and the use of hydrotherapy.

The successful treatment of hysterical paralysis will depend largely upon how fully the physician realizes that such palsies are in reality the outward expressions of a diseased will. The patient has for the time lost the capacity to originate or transmit impulses from the intellectual sphere to the motor areas which should be externalized by movements. No treatment directed toward the paralyzed part itself can be attended

by any degree of success, except in so far as it makes an appeal to and overcomes the conditions that are at the basis of this paralysis. Hysterical palsies are of various distribution and intensity. The variety known as astasia-abasia, in which the patient is absolutely unable to stand or to walk and to use the upper extremities to any considerable degree is the most remarkable. The patient is dominated by the delusion that he cannot walk or stand, and while under such dominancy he is as completely unable to do so as if he were paralyzed from organic disease. Yet when lying in bed all the extremities can be used in a normal and purposeful way. The treatment of hysterical palsy will depend somewhat upon the immediate provocative agency. When it is due to overwork, such as in machine operators, hand-workers, and the like, cessation of such labor, the application of electricity, particularly faradic or static electricity to the disabled extremity, and the customary therapeutic entailments of isolation and suggestion are sufficient. When the provocative agency is fright, which is not rarely the case in children and in young adults, I have not infrequently seen the paralysis completely disappear on engrossing the patient's attention in one way or another, and then abruptly commanding him to move the extremity. If the patient is once shown and convinced that movement is not impossible, complete functional restoration speedily follows. If, for instance, the motor capacity of one upper extremity is completely subjugated, the patient's two hands are placed in front of him, and he is asked to fix his attention entirely upon the paralyzed hand and then commanded to move the fingers of the normal hand. When this is done the procedure is reversed and attention is fixed upon the normal hand, and he is commanded to move the fingers of the paralyzed hand. Repeated and persistent efforts in this way are often rewarded by the patient being convinced that it is not impossible for him to move the paralyzed extremity, and the beginning of recovery dates from that time.

In the majority of cases, hysterical paralysis is associated with unbearable pain on movement, or rather a fear that it will cause great suffering if the parts be touched. It is sometimes feasible to overcome this delusion of pain, which can generally be done by suggestion and by the suggestiveness and soothing possessions of electricity. The patient should be convinced and schooled in the conviction that the pain is disappearing, and proportionately as it disappears the motor capacity will return. His will power should be stimulated, supported, and reinforced, and the physician should profess to be completely satisfied with small but continued evidences of improvement. Thus, by the use of physical measures which are directed immediately toward overcoming the complaint and which appeal directly and potently to the patient's mind, in association with the disciplinary and hygienic measures directed against the hysterogenic state, the prominent stigma or

associate symptom of the hysteria for which the patient seeks relief disappears with the improvement of his or her general condition. As the patient continues to develop power in the paralyzed extremity or extremities, he should be made to take methodical gymnastic exercise that will appeal not only to the muscles that are apparently derelict in their function, but to the patient's mind as well. This appeal can be supported by the use of stimulating liniments and applications to the part, by massage, and by various other measures that will suggest themselves to the physician. In hysterical aphonia sometimes the voice returns after one séance of the electrical and suggestive treatment. The patient is informed in a positive and convincing way that the application of the electrical current to the vocal cords will restore his voice. He need not be told that it will restore it completely. Then a moderately strong faradic current or galvanic current is passed through the larynx, the electrodes being on either side of the pomum Adami. At the moment when the current is passed the patient should be commanded to say "ah." This convinces him that he can produce a tone, and the mental state resulting is the one that is being striven for. The repetition of this will be followed by gradual gain. It may assist the patient in regaining the will power to speak to point out to him that he makes a tone on coughing and that this tone is similar to that produced in speaking.

The treatment of hysterical contracture is in many cases rather unsatisfactory if the condition has lasted for a long time. In recent cases it can often be made to disappear in a few days by electrical and hydriatic treatment, associated with methodical psychotherapy. The profound motor irritation which is at the basis of the hysterical contracture, at least of the recent cases, must be overcome by suggestion, either by word of mouth or by physical means, and then the general will power restored by the measures that have already been detailed for the treatment of the psychopathic state. In ancient cases a secondary contracture results, and before this can be overcome it is necessary to etherize the patient and forcibly to break up the adhesions which are the result of prolonged immobilization. To do this one may be obliged to perform single or multiple tenotomy. Naturally, after any such procedure, orthopædic apparatus must be employed to maintain the gain that has been secured.

The treatment of hysterical sensory disturbances, aside from pain and those manifest in the special senses, does not call for particular discussion. Hysterical anæsthesia and analgesia are usually first recognized by the physician who is consulted by the patient for some other hysterical symptom. The treatment directed toward the overcoming of the latter, whatever it may be, and to the counteraction of the general psychopathic state usually suffices to relieve the anæsthesia and analgesia. Sometimes physicians amuse themselves and amaze the patient by dissipating hysterical anæsthesia with magnets, a procedure dignified as

metallotherapy. The anæsthetic area is covered with strips of iron or copper, which are then influenced by bringing a magnet in contact with them, when, lo! the anæsthesia disappears. To speak of the specific working of such magnetization is to confess an entire ignorance of the pathogenesis of hysteria and its rational cure. Hysterical pain is sometimes extremely obstinate and slow in its response to every form of treatment. It is of great importance to remember that morphine should not be used for its relief. The exception to this rule is that a sufficient dose may be given internally, that the patient may be properly impressed that it is within the easy reach of the physician to cause cessation of the pain. Then some of the drugs that have been mentioned under the general therapy of the disease, and particularly those that appeal to the imagination, either through one of the special senses or by the effects that they produce in the excretions, should be given. Unless the pain delusion be very profound, relief will generally follow the application of electricity and the use of suggestion.

Sufficient has been said concerning the treatment of the stigmata of hysteria to indicate that the success of such treatment, it matters very little what individual symptom the physician is striving to overcome, will depend very largely, if not entirely, upon the control which he gets over his patient, and upon the wisdom which he displays in exercising such control to arouse the will and determination of the patient and fortify such awakening. To do this efficiently, more than the physician's mere presence or mere contact is necessary, it matters not how powerful his personality may be. The aids of which he should avail himself are those that have been mentioned in the section on the general plan of treatment. Of all these, by far the most important is isolation and its disciplinary entailment. If this one element in the treatment of hysteria were to be carried out completely in every case, the world would be happily rid of a colossal, ever-increasing literature of fasting girls, fatal hiccoughs, unarousable sleepers, miraculous cures, wonder doctors, Lourdes literature, not to speak of the volumes of incredulous testimony furnished by vendors of supernatural powers and mystery medicines.

CHAPTER XXIX.

THE TREATMENT OF EPILEPSY.

The term epilepsy is applied to groups of symptoms and to diseases which anatomically and pathologically are extremely disparate. In fact, at the present day it should not be given any anatomical significance whatsoever. To show the difficulty of conveying in a few words an adequate idea of the disorders indicated by the term epilepsy, the reader is reminded that a large proportion of all cases of dual personality are manifestations of epilepsy; that most cases of dreamy states of consciousness are in reality evidences of the epileptic neurosis; that cortical irritation, whether it be due to growths in the substance of the cortex or to pressure from without, is manifested by the phenomena of epilepsy; and finally that the large class of cases which we designate as genuine or essential epilepsy, meaning thereby a profound neurosis whose most conspicuous symptom is eclamptic or convulsive attacks, are all included under this one head. When the term epilepsy is used without qualification, idiopathic or so-called essential epilepsy, that is, the condition in which there exists no detectable anatomical lesions to account for the symptoms, is always meant.

The epilepsies are variously classified. A radical and necessary division is into (1) congenital, essential, or so-called idiopathic epilepsy; and (2) acquired epilepsy. In the first the lesion, whose nature and seat are unknown, is conditioned by factors operative upon the organism at an early stage of its development, probably at a time considerably prior to that when the disease becomes established and its phenomena manifest. The various stages in its pathogenesis are entirely unknown, and the eventual morbid state in which it results is wholly conjectural. Reasoning by analogy, from the anatomical findings which have often been described in acquired epilepsy, and from the facts set forth from a study of epilepsy experimentally produced, the theory has been advanced that the morbid anatomy of the disease is a sclerosis of certain parts of the brain cortex. It is entirely improbable that this explanation is at all adequate. Although such sclerosis has been found, it is more than likely that it is but an expression of changes that have gone on in important parts of the brain parenchyma, and that it is entirely secondary. In essential epilepsy the causal agencies act upon immature protoplasm or perhaps even upon the antecedents of protoplasm. In acquired epilepsy

the causative factors act injuriously upon tissues that already are well developed, perhaps fully so. It stands to reason that the lesion objectively considered will not be the same in both instances. Even the cases of essential or idiopathic epilepsy that develop after adolescence are considered to be the result of causative factors of remotely anterior existence and activity.

Essential or congenital epilepsy is subdivided into a number of clinical varieties, a common division being that made according to the severity and constitution of the attack. Thus, under the first subdivision we have grand mal and petit mal, or large and small attacks; and under the second, psychical epilepsy, dreamy states of consciousness, dual personality, and motor epilepsy, the common variety. Acquired epilepsy is often subdivided according to its causation and its clinical manifestations. Etiologically, we have traumatic, syphilitic, alcoholic, absinthine, and other toxic epilepsies; epilepsy of the encephalopathies, such as that resulting from lead, and the very doubtful class known as reflex epilepsies. Clinically, the acquired epilepsies may manifest themselves in the same way as the idiopathic epilepsies. As the commonest form of acquired epilepsy is traumatic, and as the trauma usually causes lesion of a more or less narrowly confined and specialized area of the brain, it produces what is known as focal or Jacksonian epilepsy. In these cases the display of the epileptic motor phenomena bespeaks and indicates the focus of the disease. This, fortunately, often allows of radical treatment, to wit, extirpation. It is only when the focus of disease encroaches upon some area of the brain to which is allocated special function, disturbance of which is readily recognized and clearly interpreted, such, for instance, as a segment of the motor area, that the symptoms bespeak unequivocally the seat of the disease. Moreover, a focal or Jacksonian epilepsy which in the beginning is attended by symptoms that bespeak the seat of the disease may, after it has existed for a considerable time, become so generalized in its convulsive manifestations or accompaniments that it is no longer possible to determine the location of the disease from a consideration of the symptoms.

All epilepsies are also divided into those which occur in early life, and those which occur in late life. Formerly these were referred to as epilepsia vera and epilepsia tarda. From a therapeutic point of view this distinction is an important one, for almost invariably the epilepsies of late life require very different handling from those of early life. The objection to such classification is that it seems to grant that genuine idiopathic epilepsy never occurs during late adult life. That this is not true will be shown by the statistics which will be cited. Nevertheless, most cases of epilepsia tarda are of the acquired variety.

Thus it will be seen that of the several different pathological conditions for which the term epilepsy may stand some are detectable and un-

derstood, while others are not. It is essential that this be kept in mind in considering the etiology of epilepsy, and that sharp distinction be made betweeen essential or congenital epilepsy and the acquired form. For, although the same factors may be responsible for both, the period of their activity is quite different. In essential epilepsy they are active before the development of the individual, while in acquired epilepsy the period of their activity is much later.

Etiology.—In order to determine at first hand all that might be learned of the etiology of epilepsy from a consideration of one's own experience, I have taken a comparatively small number of cases—one hundred and fifty—of which I have detailed histories and which were under personal observation for prolonged periods, and carefully analyzed them. The results are in many respects in entire accord with the teachings of other writers, but they differ in some rather essential particulars.

Examination of these statistics shows that 96 (64 per cent) of the patients were male, and 54 (or 36 per cent) of them females. These figures are much more in harmony with those of American than European writers. Almost all of the latter find a slight preponderancy of the female sex. Of the acquired epilepsies, the proportion of males is even greater. In 26 cases, 17 were males and 9 were females.

No age is exempt from epilepsy, either congenital or acquired. The vast majority of all cases manifest themselves during the first two decades of life; indeed, about one-half of all cases occur before the end of the first decade. My own statistics show that ninety-seven cases (or about two-thirds of the entire number) occurred before the fifteenth year. The earliest age at which an attack occurred was two weeks, the latest sixty-three years. The following table shows the relative ages at the onset of the disease in the two sexes, and sets forth graphically all that need be said as to the influence of age:

	Males.	Females.	Both.
Ages under 5	31 = 20.7 per cent.	27 = 18 per cent.	58 = 38.7 per cent.
Ages 5 to 10	15 = 10 "	3 = 2 "	18 = 12 "
Ages 10 to 15	12 = 8 "	9 = 6 "	21 = 14 "
Ages 15 to 20	13 = 8.7 "	7 = 4.7 "	20 = 13.4 "
Ages 20 to 26	8 = 4.4 "	4 = 2.7 "	12 = 8 "
Ages 25 to 30	8 = 4.4 "	2 = 1.4 "	10 = 6.7 "
Ages 30 to 35	3 = 2 "	0	3 = 2 "
Ages 35 to 40	3 = 2 "	1 = 1.5 "	4 = 2.7 "
Ages 40 to 45	0	1 = 1.5 "	1 = 1.5 "
Ages 45 to 65	3 = 2 "	0	3 = 2 "
	96	54	150
Under 15	58 = 38.7 "	39 = 26 "	97 = 64.7 "
15 to 25	21 = 14 "	11 = 7.4 "	32 = 21.4 "
Above 25	17 = 11.4 "	5 = 3.4 "	21 = 14 "

Epilepsy of all kinds is more common among the poor because of its

relationship to depravity of nutrition, superfœtation, accidents to the child at and after birth, also because those diseases and habits to which it has some relationship are more common in the parents in this class. So far as these statistics go, nationality has no influence worth mentioning.

Heredity is the most important factor in the causation of epilepsy, though very rarely is direct heredity traceable; that is, epilepsy occurring in the immediate ancestry, either lineal or collateral. It might, therefore, better be said that the neuropathic or psychopathic predisposition is really the important factor. This predisposition may be defined here as a diminished resistance to physiological and pathological irritation. Of the 150 cases only 7 gave a history of direct heredity. In 5 of these there was epilepsy on the mother's side and in 2 on the father's. It is usually stated that direct heredity is oftener traced through the maternal side. There was a history of indirect neuropathic heredity in 43 cases, distributed as follows: Alcoholism in father, 4 times; in the mother, 1; hysteria in the mother, 3 times; migraine in the mother, 3 times; insanity in the father, 1, and in the mother, 1; locomotor ataxia, 1; general paresis, 1, and tic, 1. In the remaining 27 cases there was a history of "nervousness" in one of the parents or in some immediate member of the family. Just what was meant by this term it is impossible to say in so many words, but it may be taken to indicate the existence of hysteria, neurasthenia, hypochondriasis, headache, and the like, with sufficient prominence to make it worthy of mention by the patient or parent. Twenty-seven of the 43 cases in which there was history of a neuropathic diathesis were males and 16 females, the excess of the former being scarcely proportionate to the relative difference in the total number of cases. In 107 cases there was absolutely no history of a neuropathic ancestry. These statistics show, therefore, a history of neuropathic heredity in about thirty per cent of the cases. This is slightly under the average of most writers. In only one instance was there considerable disparity in the ages of the parents, the father being 45 and the mother 15.

Alcoholism in the ancestry is not such an important factor in the genesis of epilepsy as the writings of many clinicians, especially the French, would lead us to suppose. In not very remote times much stress was laid on intoxication of one or both parents at the time of conception as a causative factor. Naturally, this would be a very difficult admission to elicit from either parent. In all probability it plays a very unimportant rôle, not more important than other factors acting to debilitate profoundly at this time.

Undue weight should not be given to the causes attributed by parents and patients. They are frequently fright and injury, but both are often concomitants of a first attack. This is well illustrated by a re-

cently observed case. The father, an intelligent man, on being asked the cause of the disease which dated, according to his statement, from the third year, said that it was due to a prolonged attack of convulsions which the patient had about seven months before the epilepsy began. He had been informed by the physician who attended the child at this time that this attack of convulsions was the result of constipation. It is scarcely necessary to add that the eclamptic attack was the original manifestation of the epileptic neurosis. In the majority of cases there is no attributable cause. It was noted in 53 cases of the 150 cases here studied, the attributed causes being enumerated as follows: Direct injury from a fall or blow on the head, 22 cases; fright, 11 cases; shock and excitement, 5 cases; overwork and worry, 9 cases; teething, 3 cases. Bathing during menstruation was the attributed cause of the first convulsion in 3 cases. This is worthy of note, as a number of writers have remarked that the occurrence of epilepsy has some relation to the establishment of the menstrual functions. Cases have been recorded in which tangible obstruction to the appearance of the menstrual flow seemed to have caused at least a symptomatic epilepsy. In 16 cases the epileptic attacks were the results of disease of the brain, distributed as follows: Hemorrhagic encephalitis, 5 cases; cerebral apoplexy, 5 cases; meningitis, 3 cases; and brain tumor, 3 cases.

The relationship of epilepsy to the occurrence of acute infectious diseases is comparatively insignificant. It was noted in 5 cases only, distributed as follows: After typhoid fever, 1; after scarlet fever, 2; after repeated attacks of malaria, 1; and after dysentery, 1.

Prolonged and difficult labor and the employment of surgical aid in delivery does not seem to have any definite relationship to the occurrence of epilepsy, judged from my own histories, although, of course, epilepsy may be a symptom of any of the infantile cerebral palsies which we know to stand in considerable relationship to dystocia.

The relationship of syphilis to the occurrence of epilepsy is sometimes quite detectable. I am not speaking now of focal epilepsy due to a syphilitic neoplasm or syphilitic inflammation, but of general epilepsy. In four of the one hundred and fifty cases the disease was considered to be due to syphilitic disease of the blood-vessels and resulting involvement of the parenchyma, because the histories showed that epilepsy had followed in the wake of syphilis within five years, and the disease proved by its response to antisyphilitic treatment that it was of syphilitic origin. Three of these patients were adult males, one was an adult female. Three of them were over forty, and one, the woman, was twenty-three. three of the acquired cases the epilepsy was apparently due to chronic alcoholism, and in one to poisoning by lead. Gout and rheumatism seem to have no etiological significance, although in a number of cases in this series there were evidences of the uric-acid diathesis, which

was interpreted as a phenomenon of defective metabolism incident to the disease.

Epileptic convulsions sometimes occur in connection with diabetes, but whether they are dependent upon the latter or the reverse has not been determined. In not one case was there any evidence that the epilepsy stood in causal relationship to reflex irritation, as from the eyes, ears, gastro-intestinal tract, or urogenital apparatus, although in nearly every case mention was made that this had been inquired into. I do not wish to be understood that there were not defective conditions of the special sense organs in a number of these cases; on the contrary, there were. These, however, were interpreted as they should be, viz., as evidences of disharmonious somatic development: stigmata of the neurosis. The influence which masturbation is said to have on the occurrence of epilepsy has no light shed on it from these statistics. Many of the patients were addicted to masturbation, but this is more likely to have been a result of the epilepsy than its cause. In dismissing the subject of the so-called reflex epilepsies, it may, therefore, be said that although nearly all writers state that true idiopathic epilepsies may be brought out by reflex irritation, this surely is one of the most uncommon causes of the disease. A person of the neuropathic diathesis may be thrown into an eclamptic condition or into a condition of grand hysteria, formerly called hystero-epilepsy, from some long-continued peripheral irritation; but even these cases are rare. It would be far better to forego entirely the question of the reflex origin of epilepsy than for the belief to become engendered that such causes play any important part in the etiology of the disease.

Careful attention and study should be given to the causes of the attack of epilepsy. Errors in diet, leading to indigestion, constipation, bodily and mental fatigue, and excitement of all kinds, but especially sexual excitement, are the commonest forerunners. The importance of obviating these will be considered in the treatment. Certain experiences would seem to have some influence in warding off attacks or diminishing their number. Of these, two only, the occurrence of infectious diseases and gestation, require mention. It has often been noted that after an epileptic patient has had a severe infectious disease, such as typhoid fever for example, the attacks of epilepsy will be very much less frequent for a considerable time. No adequate explanation for this has so far been suggested. Occasionally epileptic attacks are very much in abeyance during gestation.

It will readily been seen from the discussion of the etiology of epilepsy that few cases correspond in all important particulars. Therefore there can be no rule of thumb in the treatment of this disease. This truth unfortunately seems difficult for many to accept, for there is probably no disease in which routine treatment is more closely followed.

The first essential in the treatment of epilepsy is individualization. Next in the scale of importance come patience and resourcefulness, both of which will be put to severe test, for not weeks and months must be devoted to the treatment, but years. We may not even then be able to overcome the disease, but we can reduce the number of attacks, and as these stand in direct relationship to the mental and physical welfare of the individual, this consideration should be fully appreciated.

Treatment.—The treatment of epilepsy may be considered under: (1) The moral and hygienic treatment, which includes the dietary, disciplinary, and pedagogic handling of the patient; (2) the medicinal treatment, which includes not only the drugs employed, but the time and mode of their administration, and the measures taken to offset their disagreeable effects, and (3) the propriety of surgical interference.

The therapeusis of epilepsy varies according to the form of the disease. The plan of treatment that is applicable to primary, idiopathic, congenital, or so-called essential epilepsy is not appropriate for syphilitic, traumatic, and accidental epilepsy; nor is the treatment of either of these the same as that indicated for epilepsy which is dependent upon purely degenerative processes, such as parasyphilitic and post-inflammatory degeneration.

The reason why physicians fail so often to effect such pronounced amelioration, not to say cure, of epilepsy as to satisfy patients and their families is because they neglect the moral and hygienic treatment, and depend for their success upon the administration of medicines. Proper and simultaneous use of all gives none too good results, and no one of them should be neglected. The attitude of parents, guardians, and caretakers of epileptic patients should be made special subjects of inquiry and instruction by the physician. It is oftentimes as important as the treatment of the patient himself. There is urgent necessity of deputizing the entire administration of medicines, as well as scrutiny of the diet and the other details of treatment, to some intelligent person who is devoted to the interests of the patient. It is wise to impress upon parents, even at the beginning, the nature and probable outcome of the disease. Only about five per cent of all cases of essential epilepsy are permanently cured, even when treatment is carried out in the most orthodox way. To persist in this protracted and oftentimes discouraging treatment without becoming disheartened, especially when no considerable progress is apparent, is often very trying, and parents require diplomatic handling for the sake of the patient. The physician who forewarns and at the same time encourages will have less to regret and be less subject to recrimination than he who does not.

Moral and Hygienic Treatment.—The moral treatment—by which I trust I shall not be understood to mean only conformation to canons of ethics, for I use the term in its broadest sense—is particularly adapted to

the treatment of primary or essential epilepsy. This kind of epilepsy occurs most commonly at an age when disciplinary measures are readily carried out, and are most efficacious. Habits of obedience and truthfulness, the restraint of passions and appetites, the maintenance of emotional equanimity, of temperate mental activity, and industrious application, should be instilled. The education of these unfortunates should not be neglected. That it is, however, the records of almost every township and city will show. Their infirmity renders them liable to self-injury, and its manifestations are prejudicial to the happiness and welfare of others. Thus they are the pariahs of our public and private schools, and in the lower walks of life they soon become dependents of the community or the State. Happily, public opinion is being properly aroused to the fact that the State owes the same duty to children afflicted with epilepsy that it does to other defectives, and in many States institutions have been founded, like the Craig colony in New York, for the care and education of this class of people. In truth, the institution plan of treatment for epileptics is the ideal one, and the establishment of such epileptic colonies in many of the States, as New York, Ohio, New Jersey, and Pennsylvania, marks an important step forward in the rational and modern treatment of this disease. In such institutions epileptic attacks can be reduced to a minimum, not only by the administration of anti-epileptic medicines, but because of the ease and thoroughness with which patients can be made to conform to the above-detailed requirements. More than this, the patients can be properly educated, mentally and physically. Parents who are not able to educate their epileptic children should be urged to entrust them early to the salubrious shades of such institutions. The education should be not alone of the mind, but of the senses, and particularly of the hands. Many epileptics, if properly trained, become artisans, masters of handicraft, and laborers sufficiently skilful to earn a livelihood and often to compete with their non-handicapped fellow-men. Now and then an epileptic shows a talent for one of the arts. In such cases it should be assiduously cultivated. Modern methods for the education of backward children which teach mainly by object lessons are the best means to this end. Such details may seem pedantic, but they are warranted by the hopelessness of these cases if allowed to go on without other and more intelligent surveillance than that of the unenlightened parent. The carefully trained teacher and the intelligent physician must collaborate to make the best possible citizen out of the epileptic child. Institutional treatment where all these forms of mental, physical, and moral development can be engendered is the ideal one. The necessity for beginning the education and treatment of an epileptic early in the disease before the formation of what may be called, for want of a better name, the epileptic habit, is very important.

The hygienic treatment of epilepsy is embraced in the mode of life

of these patients, their habits, indulgences, diet, exercise, and occupation, and the position which the physician takes in regard to their assumption of such functions or obligations as matrimony and paternity. Climatic conditions do not seem to enter into the matter. The mode of life of an epileptic patient should be one that insures freedom from burdensome care and much responsibility, and one that promotes mental evenness. This is more idealistic than utilitarian, and often the patient must perforce make a compromise. It is needless to say that he should be urged to make the one that is most conducive to these ends. The contraction of all habits, unless uniform occupation be considered a habit, is to be deprecated. Tobacco, alcohol, and other unnecessary luxuries which may be injurious to the nervous system should be absolutely forbidden. The period of puberty should be carefully guarded, as epileptics are particularly prone to indulge early and most excessively in masturbation, and as many of them lack the capacity of restraint and are insensible to the deleterious moral, mental, and physical effects which such indulgence has, the greatest care should be taken to prevent these habits. Although it is impossible and often impolitic for a physician in any way to interfere with the development of normal passions, such as love, marriage for the congenital or essential epileptic should be unequivocally advised against. Every neurologist encounters not a few patients who have been advised by their family physicians to marry because of the supposed miraculous influence that marital obligations and maternity will have on this majestic neurosis. Such advice is conceived in disheartening error to the enormous disadvantage of the race. When such individuals insist upon marrying, despite the advice of the physician to the contrary, they should be urged to avoid procreation. Naturally, these strictures do not apply to other forms of epilepsy than the essential variety, unless one believes in the transmission of acquired characteristics; but in every case the neurally sound member of the contracting parties should be fully told of the obligations that are being assumed, and be made to see them through eyes unblinded by love.

Reference has already been made to the selection of an occupation or profession for the epileptic. Too much care cannot be expended in aiding the patient in choosing a calling which will not be attended with danger, providing attacks should occur during its pursuit. Unusual care must be taken to maintain the bodily health and tone of the epileptic patient; therefore, some form of exercise is of prime necessity. Any exercise that is not attended with great physical effort or that will not jeopardize life or limb, if an attack should occur while he is participating in it, is to be allowed and recommended. Of the sports, golfing is the ideal one, although bicycling may be engaged in if ordinary precautions are taken. Such violent sports as riding, tennis, football, and rowing, must, of course, be avoided, except under special conditions. What has

been said of exercise applies also to amusements. There are very few amusements that an epileptic should be prevented from enjoying. The tre-going in moderation, especially in the afternoon; social intercour if the mental state of the patient allows it; parlor games and the li all help to lessen the monotony of what is oftentimes an almost into able existence. The assumption and discharge of social and polit functions by epileptics will vary with each individual, and will hav be decided according to the mental development of the patient and exigencies of each case. In a word, it may be said that a person has epilepsy should be advised to conform his conduct and indulgences to those of a normal individual, providing they do not interfere with the regularity and equal arrangement of his life. The exception to this rule is matrimony, which should strenuously be advised against. Epilepsy is a disease the treatment of which calls for the taking of large quantities of drugs which act as a powerful depressant to the body and to the mind. In order to counteract the injurious effects of these, tired nature's sweet restorer, balmy sleep, must be obtained in liberal amount.

Dietary.—More important than all, perhaps, and very much more important than any one of them, is the question of diet. It is probable that more benefit would follow regulation of the alimentary canal, maintenance of digestion and nutrition than from the administration of the most powerful anti-epileptic drug. Like other functions of the body in epileptics, those of digestion and alimentation are often impaired; when the patient is unable to restrain the appetite, disastrous consequences frequently result. At one time it was generally taught that animal proteids should not be consumed by persons suffering from epilepsy, or if so at all, then in the greatest moderation. Those who recommended such a plan were often able to fortify their claims by statistics showing that the number of epileptic attacks in certain individuals was often considerably less when they were not allowed to eat meat. The *post hoc procter hoc* of this argument is, however, a most fallacious one: cutting off the animal foods often gives the overburdened digestive tract an opportunity to rest, and causes a partial cessation in the formation and accumulation of the products of incomplete digestion which on being absorbed into the system exercise a pernicious effect upon the highest nerve centres. Moreover, it allows oxidation and metabolism to go on more vigorously and completely, as the carbonaceous element is relatively greater in the other food stuffs. Thus benefit for a time seems to follow the elimination of animal proteids from the dietary. Far greater benefit, however, is secured when the entire dietary is carefully scrutinized by the physician.

The dietary of the epileptic patient will depend largely upon the patient himself. For young epileptics, milk is by all means the most important foodstuff, and children should be limited to it and to the easily digested

cereals. On the other hand, a mixed diet, with meat once a day, the green vegetables, cooked fruits and easily digestible cereals predominating, with plenty of water between meals, is best for the adult. No particular advantage is had from the excessive administration of fats, unless there is a tendency to subnormal bodily temperature. Fermentible substances in the diet and those difficult of digestion are to be avoided. In many cases the starches and sugar are particularly causative of indigestion. Voracious appetites are to be restrained, and food, taken slowly, should be properly masticated and insalivated. As a rule, tea and coffee, as well as all other substances that are not particularly nourishing, should be avoided.

Medicinal Treatment of Epilepsy.—I shall speak of the medicinal treatment of epilepsy under two heads: (1) The treatment of the neurosis, and (2) the treatment of an attack. I shall keep in mind the more or less typical case of primary or essential epilepsy, for this is the form in which medicinal treatment is attended with very considerable success, and because medicine is of most value in the treatment of this variety. The reason why so many cases of epilepsy under the care of the general practitioner are not very much benefited for all time by treatment is that, although the proper drugs are given, yet this is not combined with proper attention to the mode of administration, and to the details of general treatment before mentioned.

The one great drug in the treatment of epilepsy is bromine. If all other medicines having reputation as anti-epileptic remedies were lost to the profession, treatment by this drug alone would give as good results as are had from all to-day. Since their introduction by Laycock half a century ago, the salts of bromine have grown steadily in favor as anti-epileptic agencies, until now they are universally conceded the first place by those best fitted to judge. That they leave much to be desired in the treatment of the disease goes without saying, considering the prognosis of the disease even when treated in the most approved way. One of the most important lessons to be learned by the physician who essays to treat epilepsy is that they alone do not exercise a sufficient action upon the disease whatever its nature may be. It does not seem to me that the selection of a particular salt is of sufficient importance to merit considerable discussion. By some, perhaps by the majority, bromide of potassium is considered superior to any of the other salts. On the other hand, many prefer the bromide of sodium, not only because of its higher percentage of bromine, but because it is more agreeable to take and less apt to derange the stomach. Bromide of strontium has been very successful in the hands of many practitioners, and now and then some one dilates on its superiority as an anti-epileptic agent. Roche has recently repeatedly taken such a stand. Long trial of it entitles me to the opinion that it has no peculiar virtue, and that it is less reliable than either the bromide of potassium or of sodium. As a matter of fact, it is advisable to begin

the treatment of epilepsy with one of the latter salts, and if this is not well tolerated, or as efficacious as it should be, another salt of bromine or a combination of them should be tried. Occasionally, such combination, especially if given with aids to digestion and with hydrobromic acid, seems to be more beneficial than a solution of a single salt.

The bromide can be administered to the best advantage if some definite solution of the salt, such as a twenty-five or a fifty per cent watery solution, be used as a standard. It is impossible to say what the dose of the bromine salt should be. There is no more dosage according to weights and measures than there is of alcohol for a patient with typhoid fever. The dose is the amount the patient can dispose of. For one patient it may be a scruple twice a day, for another it may be a drachm or two drachms: it is necessary to make an individual study of each case. It is as ridiculous to say that the dose of bromide for an epileptic is a scruple four times a day as it is to say that the dose of quinine in malaria is five grains three times a day. No rational person would think of giving the latter directions, and no person who has had experience in the treatment of epilepsy would be likely to contend for the former. The bromide must be given up to the point of tolerance, up to the completeness of its physiological action, up to the dosage that controls the attacks, and then such dosage maintained, while measures are taken looking to the maintenance of nutrition and to the prevention of the dominancy of toxic manifestations.

After the details have been arranged to the satisfaction of the physician, he should study a chart made with the end in view of showing the frequency and time of the attacks, that is, whether they are matutinal, nocturnal, or periodic, and whether they have any relationship to the occurrence of physiological function, such as menstruation, sleep, etc.; whether they are of a petit mal or of haut mal character, and whether they are preceded by an aura. If the attacks are always matutinal the large dose of bromide should be given before the patient arises; while if they are mainly nocturnal, the large dose should be given on retiring. In those cases in which there seems to be no definite time for the occurrence of attacks, and in patients who are occupied during the day, it is my custom to give a small dose of bromide in the morning, say from fifteen to thirty grains, another during the afternoon, and a comparatively large dose, double the above quantity, at night. This plan has the advantage that it facilitates sleep, and does not produce sufficient stupor to interfere with the patient's waking time. As a rule, the drug should be given immediately before or just after a meal, unless it be desired to get its immediate effects, when, of course, it is most advantageously given when the stomach is comparatively empty. Seguin has called particular attention to the advantage of giving the salt well diluted, in some alkaline water such as Vichy, or for poor patients

in water made slightly alkaline by the addition of bicarbonate of sodium. The more liberally the dose of bromide is diluted the better will be its effect.

After the dosage of the salt of bromine has been determined, its administration should not be interrupted unless special conditions, such as the occurrence of acute adynamic diseases, demand such procedure. Natural states, such as pregnancy and lactation, are not materially affected by the administration of bromine, although the effects of the drug given to an epileptic mother are manifest in the nursing child. But as epileptic mothers should not be allowed to nurse their children, this does not require further consideration. During pregnancy special care should be taken to prevent the occurrence of epileptic attacks, and as the bromides do not seem to have an injurious affect upon the fœtus, their administration should be kept up in the customary way during this period. I desire to repeat that the desultory and irrational administration of this medicament is worse than no bromide at all, and particularly as such treatment has very little effect upon controlling the attacks, the morale of the patient becomes shattered and his hearty cooperation is difficult to secure. If satisfactory results do not follow this plan of giving the bromides, they should be withdrawn and some other anti-epileptic remedy substituted, or used in conjunction with them. The duration of the bromide treatment will depend largely if not entirely upon the effects that it produces, and particularly the extent to which the attacks are controlled by it. There should be no thought of diminishing the dose that controls the attacks until at least two years after the occurrence of the last attack. After such a period the amount of bromide may be diminished from one-third to one-half during the ensuing year. No case should be considered cured until the patient has gone at least four years without an attack while taking the drug and an additional year free from attacks without taking the drug.

In this connection a few words may profitably be devoted to the abuse of the bromine salts. I know of no drug, with the exception of those which produce habits, such as morphine and cocaine, that is so enormously outraged as the one in question. If the truth be told, the therapeutic use of the bromides is very limited, and the disease under consideration is the only one, excepting possibly migraine, that justifies the continuous, persistent administration of large quantities of any of the bromine salts. The custom frequently followed of prescribing bromide as a sort of pick-me-up merits the same condemnatory language as that used by temperance advocates against the prescribing of alcohol. It is necessary to witness only once the colossal mental and physical depravity which sometimes results from the ignorant administration of this drug for minor ailments, and sometimes even for epilepsy, fully to appreciate the truth of this statement.

The Phenomena of Bromide Intoxication and Bromide Cachexia.—That the bromides may be given successfully, the physiological action and the toxic effects of the drugs should be kept well in mind. The more common acute toxic manifestations of its use form a group of symptoms which has been described as bromide intoxication. These consist of vasomotor depression, attended with cold extremities, clammy skin, slightly depressed bodily temperature, and lowering of the vital capacity; coated tongue, fetid breath, loss of the palatal and pharyngeal reflex, stomachic catarrh, depression of sexual vigor, myasthenia, particularly manifest in the legs; unsteady gait and station, forgetfulness, slight degrees of aphasia, usually evidenced by the misuse of words and their transposition in a sentence; slowness of mental response, inability to coordinate complex mental processes, and often a considerable degree of dementia, which is probably due both to a direct action of the drug upon the protoplasmic processes of the cortical ganglion cells and to a serous accumulation in the perivascular spaces like that which occurs occasionally in acute alcoholism, and frequently in chronic alcoholism, forming the anatomical basis of alcoholic pseudo-paresis. The poisonous effects of bromides on the skin are often the earliest to develop. They consist of an eruption of acne, usually on the face and shoulders, and of circumscribed ulcerations which may become phagedenic. In acute bromine poisoning the symptoms may develop very rapidly, and to overcome it, it is not only necessary to cease giving the drug, but to adopt most vigorous measures to combat the evidences of lowered vitality. It has already been said that occasionally the symptoms are parallel to those of grave intracranial trouble, such as brain tumor.

The severe manifestations of bromism can be counteracted by the administration of restoratives, cardiac and vasomotor tonics, by drugs that have a special beneficial influence upon the skin, and hydriatic procedures that contribute to the integrity of the cutaneous circulation and at the same time improve nutrition. By means of these measures, a daily dosage of what would otherwise be toxic can be given without harmful results. The avenues of elimination of the body should be kept in active condition by the use of warm water and soap on the skin, and by the appropriate use of intestinal antifermentatives and laxatives. Ordinarily, the vehicle used for the administration of the bromine salts, alkalinated waters, gives all the diuretic effect that is requisite, but now and then it becomes necessary to stimulate the kidneys vigorously for a time. The most important measure to overcome the severe acne which often attends the administration of the bromides, aside from the maintenance and increase of nutrition, is some preparation of arsenic, preferably arsenate of soda. Unlike Fowler's solution this preparation rarely deranges the digestion. It should be given in moderately large doses for a short time, two or three weeks, and

then intermitted, and the patient encouraged to drink freely of water. If trophic manifestations reveal themselves by ulceration, the patient should be put to bed and the ulcers treated according to the principles of modern surgery, while the patient's vitality is enhanced by appropriate food, tonics, and stimulants, and of the latter opium would seem to be the best. The best all-around vasomotor tonic, stomachic, and general restorative is nux vomica or its alkaloid strychnine, which may be administered combined with dilute hydrochloric acid.

If the symptoms of chronic bromism become dominant, the patient being pale, with dry, crisp-looking membranes, stuporous, forgetful, slow of breath and of heart, depressed, suicidal, and emaciated, I have found a course of tonic hydrotherapy, associated with the administration of opium in small doses, the best means of combating them. Opium seems to prevent the neural protoplasm from wearing itself out in futile endeav ors to overcome the rapid waste of body, and to stay the latter until rest and nutrition can restore it.

When the toxic effects of the bromides are manifest by inhibition of sexual vigor and by dereliction of the vesical sphincter, belladonna is often of real service. It has in its favor the fact that it of itself is considered no mean anti-epileptic. The most potent aid to prevent bromism and its terrible consequences is the use of hydriatics. The patient who loses weight and becomes anæmic, has lowered mental and physical vitality, with evidences of profound vasomotor disturbance and glandular inactivity, is often started in the opposite direction by taking a rain bath or cold ablution in the morning, followed by vigorous rubbing and towelling, or other measures to promote reaction. Better still, whenever it is possible, these patients should take now and then a course of treatment in some one of the hydriatic institutes which are now found in most cities of any considerable size. They may be replaced, however, to no mean advantage, by cold ablutions and the cold splash bath. Caution should be used in prescribing the cold plunge or thè cold shower for these patients. Their impaired vitality, due not alone to the administration of the bromides but to the devitalizing effects of the disease, often prevents them from reacting sufficiently.

If for any reason it becomes advisable materially to diminish the dose of bromide that the physician has determined is necessary to hold the attack of epilepsy in abeyance, I consider the safest plan to be that of putting the patient to bed and keeping him there until the usual dose of bromides can be administered. Naturally, during such a time special attention should be directed to the alimentary tract and avenues of elimination.

Medicinal Adjuvants of the Bromides.—The most important adjuvant of the bromides in the treatment of epilepsy, in the experience of the writer, is opium. Its value in some cases of epilepsy has long been com-

mon knowledge, but recently Flechsig and others have called attention anew to its efficaciousness when given according to a certain plan in some cases of essential epilepsy which show themselves unamenable to the bromides alone. The plan is to give ordinary extract of opium in from five to ten grains daily, the maximum quantity being reached soon after it is begun, if possible, and kept up for six weeks. At the end of that time the opium is stopped abruptly, and one of the bromine salts given in comparatively large doses, about two drachms daily. After a few weeks, varying according to the evidences of bromism produced, the quantity is reduced one-half, and later this can be diminished to thirty or forty grains a day, in some instances to even less than this. In my own experience the attacks of epilepsy can be materially reduced in this way in almost every case that has shown itself obstinate to the ordinary bromide plan. After a year or so, if the attacks are not kept in abeyance, the opium may be repeated. I have not seen any deleterious results follow the employment of the drug in this fashion.

The combination of equal parts of chloral and bromide which is advocated by Seguin in certain cases has been put to the test of considerable personal experience, and although there can be no question of the value of such combination, especially in the treatment of nocturnal epilepsy, I have had altogether less gratifying results from its use than from that of the opium-bromide plan. The danger of forming the chloral habit, it should be said, does not seem to be so great when the chloral is given in this way and for epilepsy as it does when taken merely to produce sleep. Of the other drugs that have been persistently advocated in the treatment of epilepsy by clinicians whose names are synonymous with integrity, borax and belladonna, and possibly adonis vernalis, are the most important. I have had considerable experience in the use of borax in epilepsy, but I have never been able to convince myself that its effect upon the disease is at all comparable to that of the bromides. Yet Gowers, who introduced it as an anti-epileptic agency, has recently testified to its frequent efficacy. In cases in which for some reason the bromides cannot be given, it is one of the best substitutes. It should be given in powder or solution, fifteen to thirty grains three times a day. As a rule, the only bad effect of such administration is an occasional attack of psoriasis which can be combated by giving arsenic, but borax has a tendency to derange the gastro-intestinal tract and to irritate the kidneys.

Belladonna and its alkaloid atropine, digitalis, and, more recently, adonis vernalis, have been recommended in epilepsy, either alone or in combination with the bromides. One is never justified in giving them alone, at least not in the hope of effecting a cure; very frequently, however, they become important aids to offset some of the disagreeable accompaniments of bromide administration, to restore cardiovascular tone, and to aid the system in carrying off the bromides. The preparation of

these drugs that is usually recommended is the tincture, the first two in doses of from five to ten drops, while adonis vernalis is given in from ten- to twenty-drop doses. They have the advantage that they may be administered with the bromides. With the exception of borax, none of them deserves the name of substitute for bromides.

A number of other substances, such as the salts of zinc, simulo, antipyrin, acetanilid, nitroglycerin, nitrite of amyl, horse nettle (solanum carolinense), antirabic injections, and so on to a tiresome enumeration, have been undeservedly praised and hailed as cures of epilepsy. With the exception of simulo and antirabic injections, each of these has a place in the therapeutics of epilepsy, but only to fulfil some certain definite mission and to be used symptomatically. For instance, in cases in which a distinct vasomotor manifestation precedes an attack in the shape of an aura, the administration of nitroglycerin with the bromides seems to have a particularly beneficial effect, especially in petit-mal attacks. Measures that have been extensively written of as anti-epileptic agencies, and which I believe are not of the slightest value, are hypnotism, electricity, hydrastinine, duboisine, picrotoxin, cannabis indica, amyelin, osmic acid, sclerotinic acid, and cocculus indicus. It may be difficult to believe that any of these substances has been praised as efficacious, but a review of medical periodicals shows such to be the distressing truth. None of them deserves a trial. Naturally, the salicylates, beta-naphthol, oil of peppermint, hydrastinine, and cannabis indica may be used symptomatically in epilepsy, as they are in innumerable other diseases; but we are not now considering the symptomatic treatment of epilepsy.

After briefly referring to the various substances that are used in the treatment of the epileptic neuroses, it is seen that the one substance to which faith should be given is some salt of bromine. The others that have been mentioned with favor are aids to the bromides or substances that can be made use of when the administration of the former is denied. The surgical treatment of epilepsy is not referred to here because there is no such thing as the surgical treatment of idiopathic or essential epilepsy. I shall have occasion to consider this topic when speaking of traumatic and accidental epilepsy. Here there remains only to be considered what may be called the moral treatment of patients and parents, which is of no small importance in attaining the desired results in the handling of the epileptic patient.

Now and then we encounter patients who are unwilling to undergo the bromide plan of treatment, which often entails considerable suffering and deprivation. To overcome their objections, it has only to be shown to them, or to their parents, in a convincing manner that they are afflicted with a disease almost uniformly progressive in its course, which in the majority of cases, if untreated, leads to the pauper or insane asylum, or to the custody of a caretaker if worldly circumstances allow. It should be

impressed upon them that the plan of treatment advocated, although it does not often completely cure the disease, frequently so far restores the patient to health and freedom from attacks that he is able to discharge the duties of citizenship and meet the requirements of society. The bromism, mental deviations, impaired energy, and the other symptoms which long-continued use of the salts of bromine sometimes produce, will be looked upon as naught when contrasted with the misery which the continuous manifestations of a progressive epilepsy entails.

It has often been remarked that new plans of treatment and change of doctors are as beneficial to some epileptic patients as change of air and clime are to other invalids. This is not difficult to explain. The new physician inquires more closely into the diet, gives more stringent directions as to mode of life, and starts the administration of medicines on a definite plan. Similar activity and care on the part of the first physician would have secured equally good results. It is this persistent attention to what may seem minor matters: regularity of eating, bathing, giving of medicines, and suitable disposal of time among work, relaxation, and rest, and all that hospitalization implies, which makes the result of institution treatment better than that of private practice.

Treatment of the Attack.—An epileptic attack is usually very alarming to those who witness it, and the family of the patient often insist that something be done to assuage it. Unless the tonic spasm is very severe and continuous, the attack requires no treatment save to place the patient in such a position that he cannot injure himself or destroy things about him, and await the natural cessation. It is usually necessary to place something like a piece of cork, rubber, or the folded end of a handkerchief between the teeth so as to spare the tongue when the tonic spasm of the masticatory muscles forces the jaws together. If the patient is bound about with clothing, it should be loosened so that respiration and cardiac action be in no way impeded. The plan of giving a hypodermic injection of morphine which some physicians pursue when called to a patient in an epileptic attack is unnecessary, and should be discouraged. In some cases it becomes necessary to employ measures to cut short the convulsive part of the attack, particularly when there is a tendency for the patient to go into the condition known as status epilepticus in which convulsive phenomena succeed one another with great rapidity, often without any intervening period of stupor. The best means for cutting short such an attack consists in the inhalations of chloroform, given alone or combined with inhalations of nitrite of amyl. This procedure should be done in every case in which the tonic spasm is prolonged. Occasionally after a prolonged status epilepticus, or after a number of attacks occur in rapid succession, the patient goes into a state of partial or complete coma, and this requires vigorous treatment. The most useful measures in such a condition are drop doses of Croton oil if constipation exists, followed

by the administration of generous quantities of black coffee by the mouth or by high rectal injection, possibly also of other stimulants, small doses of belladonna, and the application of an ice-bag to the head. Occasionally I have found it necessary to use subcutaneous injections of normal salt solution.

In almost every case those about the patient have something to suggest that is said to be of service in cutting short the attack. Causing the patient to swallow a quantity of salt or salt water, as is seemingly often done, should not be allowed. Another procedure which does no particular good ordinarily is the immersion of the patient in hot water, especially in the case of children. Whenever it is necessary to employ means to cut short an attack, the way already mentioned is the rational as well as the efficacious one. It should be borne in mind that attacks are liable to occur at night, and occasionally patients suffocate themselves by crowding the face into the pillow, and precautions must be taken to avoid this. When the convulsive part of the attack is over, the patient should be given concentrated liquid nourishment and mild stimulants, such as black coffee, and an effort should be made to prevent him from going at once into a stuporous sleep, from which he awakens after a variable but prolonged time, feeling as though he had received severe corporal castigation, and with a confused, exhausted feeling in the head. After the patient has fully recovered from the attack, that is, after consciousness has been fully restored, there are no objections to his going to sleep. Indeed, this is the most refreshing measure.

In some cases of epilepsy in which the convulsive phenomena are preceded by a warning, particularly in those who have a sensory aura pass toward the head from one of the extremities, the attack may be prevented, or its severity modified, by subjecting the part from which the warning sensation passes to a smart blow or other sensory impression. Just how the stimulus acts to cut short the attack is a problem in neural physics that no one has adequately explained. The warning given to the patient is never far removed temporally from the oncoming convulsion, and therefore the sensory insult must be made by the patient himself. To aid him in doing this, it is suggested by Jackson that a girdle be worn beneath the sleeve above the wrist, the usual starting-point of the aura, and as soon as the patient feels an attack coming on to give the girdle a powerful twist, or if a loop, to tug at the two ends. It is astonishing how often this arrests the attacks in patients who have this kind of warning. Unfortunately, these are very few compared with the entire number of epileptics. Occasionally the arrest of attacks in this way robs the epileptic phenomena only of the convulsive part, and the vertigo, stupor, and feeling of prostration are just as severe as after an ordinary attack.

Treatment of Dreamy States of Consciousness.—The general treatment

of the different clinical varieties of the epileptic neurosis is practically the same, it matters not what the form may be, except in that rare and ill-understood condition to which the names dreamy states of consciousness, states of reminiscence, etc., are given. At the present time, this condition is looked upon as a form of epilepsy affecting the sensory side of the organism. Clinically and pathologically, it has not received the consideration that it deserves. It has many of the features of epilepsy of the motor side of the organism, but there is one very radical difference in my own experience, and that is that it does not tend to become more pronounced or more frequent in its manifestations as time goes on. Another very important fact that has been impressed upon me relative to this condition is that the bromides are of little or no service in its treatment. On the contrary, iodide of potassium or of sodium given in tonifying doses seems to be more serviceable. Best results are had from restorative measures, hygienic and dietetic, and from building up the patient according to the plan detailed in the chapter on neurasthenia.

Treatment of Epilepsia Tarda.—The treatment of epilepsy that develops for the first time in later life, so-called epilepsia tarda, is a different matter from the treatment of essential epilepsy which develops at the customary period. In the majority of cases, this form of epilepsy is an expression of syphilis, alcoholic poisoning, or some diathetic condition which has existed long before the epileptic attacks, and it is necessary to combat this while treatment is being directed to the superimposed symptom. Just what the indicated medication will be in any given case depends upon the diathesis. It is necessary, of course, in these cases to employ a real anti-epileptic drug, such as one of the salts of bromine. Its beneficial effects are enhanced by giving it simultaneously with iodide of potassium and perhaps also nitroglycerin. Tonifying measures are of great importance in this variety of epilepsy, and should be vigorously employed. In this respect the treatment is very similar to that of the parasyphilitic variety of epilepsy. The danger of status epilepticus is particularly great and there should be no hesitation in attempting to cut it short with chloroform and nitrite of amyl inhalations.

Treatment of Epilepsia Procursiva.—In epilepsia procursiva, and in some other conditions in which the epileptic equivalent displays itself in the shape of psychical manifestations, it may be necessary to restrain the patient from doing injury to himself and perhaps to others. This is particularly incumbent when the patient does not appear to be devoid of his faculties. Some sleep seizures, usually reckoned as somnambulistic, are often of an epileptic nature, and their occurrence calls for stringent measures taken to combat the neurosis. Likewise, a considerable proportion of all cases of dual personality are to be interpreted on the basis that one personality is normal, the other an epileptic equivalent.

Traumatic and Accidental Epilepsy.

Under this heading may be grouped all the cases of epilepsy that do not belong in the category of primary idiopathic or essential epilepsies. They are usually and properly called symptomatic epilepsies. In the beginning the true epileptic neurosis has no existence, but the habitus epilepticus not only may but does develop if the disease continues for any considerable length of time. The term traumatic epilepsy sufficiently explains the pathogenesis of the condition. There is some irritation of the motor cortex due to trauma which expresses itself in epileptic attacks. The accidental epilepsies are those symptomatic of some disease, the most common being new growths of the brain substance or of surrounding tissues, causing encroachment upon the brain. Another variety of accidental epilepsy is the parasyphilitic variety. Remotely anterior syphilis produces epilepsy sometimes, not by causing syphilitic lesions in the meninges and cortex, but by setting up in the part a degeneration comparable to the lesions of tabes and general paresis—syphilitic in origin, but not characteristically syphilitic in nature. Such cases are rare, but there can be no doubt of their occurrence.

It would seem that the treatment of the traumatic and accidental epilepsies might be summed up in a line: overcome the disease or relieve the condition upon which the epilepsy is dependent. Thus the treatment will vary with the causal conditions. If it is due to trauma that has set up changes of an irritating nature in the cortex of the brain or in the juxtaposed tissues, and if it can be localized, the appropriate treatment and the only one that should be at all countenanced is to excise it at once. Experience of the last few years has taught that the skull cavity can be entered, if done with great skill and care, without materially jeopardizing the patient's life. Therefore, if there are any positive indications that the epilepsy is dependent upon a focal lesion, it matters not its nature, trepannation should be done at once. If the lesion that is the cause of the epileptic attacks is found, be it of the calvarium, the meninges, or the cortex, it should, if possible, be completely excised. It should be borne in mind that the danger to the patient is not materially added to by the removal of a generous piece of the cortex in which the lesion is situated or on which it has made destructive pressure. Of course, if a specialized area is excised, there will be corresponding loss of function. Although this functional loss is in the beginning proportionate to the amount of the cortex excised, it is rarely permanent. The reason why so many cases of Jacksonian epilepsy fail to be cured by operation is that the operation is not undertaken early enough. If the diagnosis can be made before any considerable amount of pathological change goes on in the brain to form the anatomical basis

of genuine epilepsy, the chances of success are good—much better than some writers are willing to concede. This statement holds true only when the operation is undertaken before the patient has had many attacks. I have had two cases that fulfilled these conditions, successfully operated upon. One patient was operated on four years ago, and a considerable area of cortex which showed striking changes of meningo-encephalitis excised. He is still free from attacks. Another patient, operated on three years ago, for localized meningo-encephalitis dependent upon depressed fracture, has likewise remained free. In the first case the diagnosis was made and the patient operated upon after the second convulsive attack. In the second case the patient had not had more than a half-dozen attacks, perhaps less. An important point to be remembered about these cases, in addition to what has been said, is that even though the operation has ameliorated or apparently cured the disease, the patient should be kept upon moderate doses of bromides for from two to three years after the last attack. When the duration of the disease, the nature of the lesion, and the character of the attacks indicate that it is beyond the pale of operation, the treatment is in nowise dissimilar to that of essential epilepsy. The treatment of epilepsy which is symptomatic of new growth, pressure, or any localized lesions, is to remove the source of the disease completely, and when this is not possible, partially. Naturally, there are many organic conditions that are in no way amenable to surgical treatment and that do not allow of surgical interference.

Surgical Treatment.—It is necessary to say a few words under the caption of the surgical treatment of epilepsy, this being the mode of expression continually encountered in the literature. I have already said that there is no such thing as the surgical treatment of epilepsy, save the traumatic and accidental varieties. This statement must naturally seem paradoxical in view of the amount of literature that is put forth every year in which the most irrational, not to say absurd, surgical procedures are recommended in apparent seriousness as justifiable measures in the treatment of this majestic neurosis. In this category are included such procedures as stretching of the pneumogastric nerve, exsection of the cervical sympathetic, castration, ligation of the vertebral arteries, ocular tenotomies, circumcision, hysterectomy, clitoridectomy, castration, removal of spurs from the nasal septum, ligation of the vertebral arteries, and so on to a most distressing end. Many of these operations have been originated and have come into vogue because of the former widespread acceptation of the theory that epilepsy is often a manifestation of reflex peripheral irritation, and particularly irritation of some special sense or highly endowed organ of tactile sensibility, such as the sexual organs. There is no doubt that a symptomatic epilepsy may occur from peripheral irritation, and that such epilepsy deserves to be called reflex. But this condition is in no way a dis-

ease comparable to primary, essential epilepsy, or even to a toxic epilepsy. These reflex, symptomatic epilepsies are very rare, compared with the cases of ordinary essential epilepsy. Their consideration by enthusiasts and faddists has already done immeasurable harm, and the past history and literature of reflex epilepsies, as well as the makers of such histories, deserve speedy oblivion. No properly trained physician ever fails to examine his patient completely, and if he discovers a condition of the foreskin that is interfering with its functions he removes it, just as he would remove a thorn from a man's foot that interfered with walking, but this does not prompt him to tell the profession of his success in making the lame walk, nor does he desire to be considered an orthopædic surgeon. No more should a physician who releases an adherent clitoris, anchors a fallen womb, or balances an eye, claim to be the discoverer and possessor of a new method of treating epilepsy, just because such restoration of an organ to its proper condition allows it to functionate normally and thus to overcome what may have been a most important source of peripheral irritation. Such conditions as these do not produce the neurosis epilepsy, nor does the overcoming of them cure the neurosis epilepsy.

To summarize the status of surgical interference in the treatment of epilepsy, it may be said that: The present generation has witnessed the most remarkable advances of surgery that have ever been made. This may in a way account for the furore that seems to have taken hold of surgeons the civilized world over a few years ago of operating on all sorts and conditions of epilepsy. If this does not encompass the explanation, I am unable to suggest it. That such a furore existed, no one who will examine the literature can deny. The result of it is to-day that operation on the skull, trephining with incision of the membranes and removal of the cortex, is justifiable only in the traumatic and accidental epilepsies in which the lesion can be localized. Absolutely nothing is to be gained from subjecting any other form of epilepsy to operation. It has often been noted that in almost every case after operation there is a temporary cessation of greater or lesser duration of the attacks. This has been attributed to the effects of the operation *per se*, and it has been pointed out that a corresponding respite follows any operation, it matters not on what part of the body it is made. I am inclined to believe that the operation *per se* has very little to do with diminishing the number of the attacks. The improvement is probably due to hospitalization, limited, selected diet, careful nursing, the discipline of regularity, enforced rest, and increased sleep.

The Treatment of Syphilitic Epilepsy.—Genuine syphilitic epilepsy, that is, the epilepsy of luetic meningo-encephalitis, gummatous infiltration of the meninges, localized syphilitic disease of the blood-vessels in the Rolandic area, and of cortical gummata, a condition which

naturally occurs after adult age has been reached, except in rare cases of inherited syphilis, requires vigorous antisyphilitic treatment. It depends upon the nature of the syphilitic process, and the time that has elapsed between the initial lesion and the present disease, just what the antisyphilitic treatment will consist of. The rules given for the treatment of syphilis of the nervous system in the chapter on that subject apply here. This form of epilepsy often assumes the Jacksonian type. When such cases can be diagnosticated as syphilitic, naturally they should not be subjected to operation for removal of the *materies morbi* until antisyphilitic treatment has been tried and found lacking. But the mistake of allowing such patients to go on having epileptic attacks, especially when the indications are that the gumma is in a part of the brain that can be easily got at, should not be made, after a short, vigorous course of antisyphilitic treatment fails to give relief. The scar-like tissue that is occasionally left after absorption of syphiloma sometimes keeps up symptomatic epilepsy after the real growth has disappeared under medication. There is no reason why such scars should not be excised, and the surgeon should be urged to undertake it. If, on opening the skull, remains of the syphilitic new formation are found they should be removed as well.

The treatment of parasyphilitic epilepsy is entirely different from the treatment of genuine syphilitic epilepsy. In the former antisyphilitic measures are worthless, if not worse than useless. If it be granted that after death these cases do not reveal lesions in any way of a syphilitic nature, it is difficult to suggest a reason why such patients should be subjected to antisyphilitic treatment. Yet this is the treatment which many of them receive. The treatment that they require and the one that is most serviceable, is the combined tonic and bromide plan, the nutrition being kept up to the highest possible point all the time. These cases do not tolerate any such quantity of bromide as a case of essential epilepsy does, and it is necessary to be on the careful lookout for toxic symptoms of this drug, for in such cases sad results from careless or excessive bromide administration are often seen.

CHAPTER XXX.

THE TREATMENT OF THE TIC NEUROSIS.

THE word tic means literally a twitching. It is applied to an abrupt, rapid, and usually uncontrollable movement, the result of abnormal contraction of individual muscles or groups of muscles which normally act together to fulfil some physiological purpose. The designation "tic" is a most appropriate one, though it has stood in the way of the condition being more generally understood as a pathological entity. It has been difficult for some to believe that the ordinary tics are not in reality habits, one variety having been described as a habit-spasm. Others have unfortunately considered the tics as atypical manifestations of chorea, and the dread phrase "a kind of chorea" has been applied to them. Tic has no more in common with chorea, be it acute or chronic, than it has with epilepsy; indeed, I am inclined to believe that it has much less. The atmosphere of the tics has been very much obscured by the use of the word choreiform to describe the movements; also by their being considered with chorea in systematic medical treatises. We cannot drop the terms choreic and choreiform, but if we could when speaking of the tics it would be a decided gain.

It is important to understand that the term, although it suggests only the most prominent symptom, often bespeaks an abnormality of the nervous system quite as demonstrable as that to which the term epilepsy, hysteria, or migraine is applied. When the latter words are used, a certain well-defined significance is attached to them, and they call to the minds of the users clearly cut clinical pictures and well-known data concerning etiology and pathology. It is unfortunate that the word tic does not do as much. The only reason why the names hysteria and epilepsy have a more decisive application is that the conditions for which they stand have been more carefully and persistently studied. A similar amount of labor expended upon the tics would be followed, I venture to believe, by a corresponding amount of information.

All tics may be classified primarily into (1) senile (acquired) tic, and (2) early tic, the last being further divided into two varieties, viz., (*a*) degenerative and (*b*) acquired.

The senile variety is a convulsive or spasmodic manifestation in one part of the body or another, usually in the face, almost invariably due to, or at least accompanied by, degeneration of the blood-vessels, arterio-

capillary fibrosis. The twitching is usually of the fronto-orbicularis or facial musculature. Pathogenetically it is an entirely different affection from the early degenerative types. In short, it is usually the symptom of a well-understood pathological condition, and the treatment which it requires, aside from that which is symptomatic, is none other than the treatment of this condition. To this form I shall not therefore again revert.

Early tic, degenerative or acquired, may be divided into two groups: (1) Motor tic, which may be further divided into (*a*) localized tic, (*b*) generalized tic, and (2) psychomotor tic, which may also be further divided into (*a*) tic which is a response to a compulsory idea or obsession, (*b*) tic caused by co-ordinated movement, associated with intellectual or emotional externalization, orderly or disorderly.

The motor tics, although in all likelihood often the expression of a similar abnormal condition, are much less complex than the psychomotor tics. But despite this fact they have been much less studied. One reason for this is that the localized varieties have usually been regarded as habit-spasms and the generalized tics as forms of chorea. The psychomotor tics, and particularly group *b*, have been rather extensively studied since Gilles de la Tourette turned his attention to them, and since it has been understood that a condition very like the psychomotor tics occurs in certain parts of the world as a tribal and family affection, and under other conditions as apparently the result of some toxic or infectious agent. Such, for instance, are the "jumpers" found in that portion of New England bordering Canada, Myrachit of the Siberians and Kamchatkans, and Latah of the eastern coast of Africa. The psychomotor tics, especially in this country, are, moreover, relatively uncommon when compared with the purely motor form.

Motor tic may be further classified topographically. Such a classification facilitates recognition of the condition. Thus we have (*a*) fronto-orbicular tic, (*b*) nasal and naso-orbicular tic, (*c*) facial tic, (*d*) nuchal tic, sometimes called spasmodic torticollis; (*e*) tic of the diaphragm, often called respiratory tic; (*f*) bowing tic, or *tic de salaam*, as it has been called; (*g*) string-halt tic.

Etiology of the Tic Neurosis.—Very little definite and positive information is to be had in regard to the etiology of tic. Tics of all kinds occur in early life, in childhood, and in early adolescence. The disease afflicts males more commonly than females, and the victims frequently have neuropathic parents and brothers and sisters who manifest other forms of nervous disease. Occasionally the twitching follows emotion, fright, bodily and mental fatigue, and is often associated with somatic and psychic defects. In other words, tic is frequently a possession of the superior and inferior degenerates, and it manifests itself during the formative period of the person's character. This must

not be taken to mean that tics are invariably stigmata of degeneration. The simple motor tics may occur in individuals who have nothing in their antecedents to suggest an inherent neuropathic constitution, and no bodily or mental attributes which can be called stigmata. They may be merely an expression of some peripheral irritation. For instance, fronto-orbicular twitching or even facial tic is sometimes dependent upon defect of the visual mechanism or loss of ocular balance. Nasal and facial tic movements are at times an expression of irritation of the naso-pharyngeal passage by inflammations or new growths. Spasmodic torticollis may be the result of some comparatively slight irritation to the substance of the muscles manifesting the spasm. Many of these simple tics continue after the original cause of their existence has been overcome. They then approach habit twitchings. The simple motor tics may be the result of many different conditions which cause some functional change in the motor areas of the brain or in the subcortical motor stations. The immediate antecedent condition is, in all likelihood, a depravity of nutrition. This harmonizes with my experience that tic is not infrequently seen in rachitic children, in young individuals who have acquired a rheumatic diathesis, and occasionally after acute disease. Tics may occur in persons who have voluntarily imitated the twitching movements of others, and if such are not possessed of a stable nervous system, the tic often develops so strongly that it cannot be controlled. Such persons are abnormal when considered from a neural standpoint.

The departure from the normal indicated by the word tic is in the majority of cases akin to that indicated by the words epilepsy and hysteria. I am inclined to the belief that tics taken as a whole bespeak, with greater uniformity than any other one condition, a state which may be designated, at the present time, only as one of degeneracy. This is using the word in its biological and proper sense as signifying a loss or impairment of the qualities peculiar to the race or type, and not in its pathological sense as synonymous with decay. Tic itself is not inherited, but the neuropathic predisposition may show itself in other almost innumerable conditions, mental or physical, showing a departure from the normal. This is true of all the degenerative nervous diseases. It is rare to learn that a patient's parents or immediate relatives have suffered from some twitching disorder; but it is not uncommon, indeed it is the rule, to find that there is some allied neurosis or psychosis in the family.

Particular investigation of the cases of tic which have come under personal observation during the past five years, since my attention was first attracted to this view, has shown that tic is associated with somatic and psychical stigmata of degeneration in greater proportion than any other nervous disease. I have full notes of fifty-seven cases of tic, and have

seen a much larger number of which I do not possess notes. On looking through the histories of these cases I find that such stigmata of degeneration were sufficiently obvious in thirty-two of them (about sixty per cent.) to call for specific notation. In others, I recall such stigmata, even though there is no note of their existence.

Almost without exception they have the accompaniments of the degenerate state. The twitching movement, the tic, is an outward expression of such degeneracy. In one case it takes the form of an uncontrollable grimace, in another of a barking sound, and in a third it passes through the gradations of a rhythmic-like spasm of the muscles of the trunk to a twitching of the muscles of the head and of the neck. All these forms of tic have certain general features in common, but these features merge gradually one into another, and it is quite impossible to say what form they will take in this case or to what extent they will go in that. When we come to analyze the psychomotor tics, we at once experience great difficulty in separating them by hard and fast lines from the manifestations of other diseases of degeneracy. It is difficult to say just wherein they differ from the abortive types of rudimentary paranoia; from the obsessions which accompany the neurasthenic state developing in children and in early adult life, which I am inclined to believe is another manifestation of degeneracy, and from the manifold psychical compulsions and accompaniments of hysteria. But there are certain general features accompanying the tics which one soon learns to associate with this condition and not with the degenerative disorders just mentioned. In the first place, the twitching movements themselves, if carefully studied, are readily differentiated from hysterical motor manifestations. In the latter disease the motor phenomena are tremor, contracture, tonic convulsions, or flaccidity. None of these occur in tic. Above all, we must not delude ourselves into thinking that it has anything in common with chorea. That term when used as a descriptive adjective should be applied only to an acute, infectious disease primarily of the blood, a self-limiting disease known as Sydenham's chorea, and a hereditary chorea, dependent upon chronic parenchymatous degeneration of the cortex of the brain and known as Huntington's chorea.

Not infrequently tic patients have certain abnormal bodily conditions which are believed by some to be causative of the tic. Some writers have been so illogical as to contend that if these were remedied the tics would cease. It is very certain that patients with tic often have misshapen eyeballs which call for corrective glasses; that the musculature of their eyes is sometimes badly balanced; and that other peripheral sense organs may show departures from the normal. But I am firmly convinced that these are the rightful possessions of an individual whose evolution toward the type which is now looked upon as normal has been imperfect. Moreover, no means should be left untried to correct these shortcomings, but

they should not be said to cause what is really another manifestation of the degenerate state.

To summarize in a few words my conception of tic, it may be said that, leaving out acquired motor tic, both the early and later varieties, it is one of the diseases of degeneracy; that its association with somatic and psychical stigmata of degeneration entitles it to be classed in this category; that it conforms in its occurrence, in its development, in its progress, and in its attitude toward treatment with all the degenerative diseases; it occurs in the early years of life and develops gradually; its unimpeded tendency is toward progression, and it responds most tardily to therapeutic measures.

It is quite possible that the psychogenesis of coprolalia and the like concomitants of psychomotor tic is that the words constituting it have been heard on the street or elsewhere and are registered upon the auditory tablets of the brain; but they never become a part of the conscious vocabulary because they are not passed through the speech areas of the brain to the intellectual areas. Nevertheless, they may be externalized by uncontrollable forces in a way that makes their manifestation analogous to the twitching movements of tic. Indeed, the motor impulse may be a very similar one, acting, however, through the entire articulatory apparatus to produce words.

In estimating the prognosis of tic, a number of factors are to be taken into consideration. Tic is a condition which disorders life but does not destroy it. When we consider the prognosis we consider in reality the chances which the patient has of ridding himself of this manifestation of shortcomings in development or evolution. Like all elementary troubles the natural tendency of the tics is to progress, and it is this progression that may make it more difficult to preserve health. In general it may be said that the earlier the tic develops the less are the chances of its amelioration and cessation. Likewise, it may be stated that the more extensive the development and the more vital the parts in which the tic phenomenon occurs, the less are the chances of cure. It is my experience that a generalized motor tic is almost always progressive, no matter what is done for it, and that a tic of the diaphragm is more stubborn to treat than a tic of the face. Again, it may be said that the greater the number and the intensity of the stigmata of degeneration—in other words, the further the patient is removed from the normal—the less are the chances of assisting him to approximate normality. And, lastly, the longer the symptoms have existed, the greater is the difficulty in ending them. Patients with tic who have many psychical stigmata rarely become normal persons. They may be bettered, but the mental accompaniments are every now and then likely to show their dominancy. In reality, there are few diseases in which the physician is obliged to temper his prognosis with so little assurance of recovery as in the psychomotor tics.

Treatment of the Tic Neurosis.—The treatment must be considered under two headings: (1) The treatment of the most annoying symptom, viz., the twitching and its psychical accompaniment, if there be any. (2) The treatment of the neurosis, of which the main symptom is but a manifestation.

The treatment of the twitching varies according to the nature of the tic, that is, whether it be an acquired or a degenerative condition. If it be an acquired condition, the treatment is very simple and means the removal of the cause. If it can be removed the symptom will usually disappear with it, although often it is necessary to use at the same time measures which will build up the nervous system, particularly as such simple acquired tics are most common in neurotic subjects. Orthopædic and surgical measures are of service in the treatment of certain forms of both acquired and degenerative tic. Spasmodic torticollis is sometimes overcome by methodically suspending the patient by means of the head-piece of the apparatus made to suspend tabid patients. Spasmodic wryneck is sometimes alleviated by giving large doses of fluid extract of conium, sixty drops in twenty-four hours, and by the hypodermic administration of atropine. The galvanic current applied to the side of the neck oftentimes gives relief, particularly if the condition is painful, and massage is often of real service. Stretching of the facial nerve for facial tic and resection of the spinal accessory nerve and of the posterior branches of the four upper cervical nerves has been resorted to many times. If the procedure is thoroughly done, naturally it overcomes the spasm even though the tic be of the degenerative variety.

It will be understood that none of these measures can cure in the degenerative forms of tic. To overcome the disease in these cases, it is necessary to go behind the symptoms and to direct treatment immediately toward the general health, so as to maintain as normal a state of health as the neural conditions with which the patient is born will allow. The necessity of putting all the bodily functions at their best is apparent to every one. This is so plain in the treatment of all chronic and degenerative diseases that it seems trite and puerile to refer again to it; but as tic is one of the diseases in which the utility of such measures is often more manifest than in others of its kind, it is perhaps permissible to mention it. No one measure can suffice to accomplish this end. If the patient is a child and in school, he or she should be removed and encouraged to lead a rollicking outdoor life, and be given a course of tonics, while the various hydriatic and hygienic measures for the betterment of the health are employed. In some instances the discipline of partial isolation and the removal from parents and members of the family is of considerable service, particularly if the tic is associated with an emotional state, or occurs in a very nervous person.

All sources of pathological reflexes should be investigated; the eyes,

the ears, the nasopharynx, and the genital organs should be passed in review, and any deviation from the normal corrected; but the physician who sees in tic one of the manifestations of the degenerate state will not beguile himself into the belief, nor mislead others by the promise, that such patching can replace the evolutionary work of centuries. He will learn to differentiate the simple tics which are symptomatic of some local departure from the normal and the degenerative tics, and shape his words and course accordingly. Simple facial tic in children is often found associated with some disease of the nasopharynx, and treatment directed immediately to this condition and kept up persistently will overcome the twitching in the muscles of the face. I have notes of a number of cases in which such treatment has been efficacious. The indications for treatment are as direct as they are in the treatment of what has been called watchmaker's tic, an occupation neurosis manifest in the orbicular muscles following the use of the glass which these artisans hold in the orbit. In short, the source of the twitching being removed, and the general health of the patient cared for, recovery follows.

The treatment of the neurosis of which the tic is a manifestation is practically the same as the treatment of any other degenerative condition, subject to individual and selective variation. The measures to be utilized are hygienic and medicinal. The hygienic should have in view, first, the development of the body, and, second, the development of the mind, and the medicinal should find its object in increasing the potentiality of life in the cellular elements of the higher tissues.

The education of children with tic should be along the same lines as that of children who have hysteria or epilepsy, and with the same object in view, viz., to increase the stability of the nervous system while the nutritional state is kept as near to perfection as possible.

Medicinally there are few drugs, aside from those that contribute to restoration of nutrition, that are of any service. Two of the minerals, sulphate of copper and nitrate of silver, are given empirically and have often been recommeded. In a number of instances I have seen very beneficial results follow their use. It is impossible, of course, to say how these alteratives act or what they do to influence the progress of the neurosis. If they are administered in a desultory fashion, or if they are given for a short time only and in a more or less haphazard way, their use will be very disappointing. They should never be alone relied upon to benefit the neurosis, but should be employed as adjuvants to the disciplinary, hygienic, and moral treatment which has already been referred to.

In the minor forms of tic, it is sometimes possible for the patients to control the twitching, partially or completely, by an effort of the will, and they should be encouraged to do so. In the more severe forms, and in cases of generalized motor tic, the twitchings are materially lessened, or indeed they may cease, while the patient is indulging in absorbing

occupation or sport. I have seen marked benefit follow the use of the bicycle. The tic movements often stop entirely at such times and the longer they cease the better for the patient.

Summary.—In conclusion: Tic is, in the majority of cases, a degenerative neurosis; its most prominent outward manifestation, viz., the twitching, the one from which it takes its name, is a stigma of degeneration, just as hemianæsthesia is a stigma of degeneration in hysteria; its next most common stigmata are psychical and consist of compulsions, obsessions, and possessions; tic occurs in individuals who have stigmata of degeneration; and it is one of the degenerative diseases which develop early. Simple motor tic, let us say tic of the musculature of the seventh nerve, oftentimes is a reflex condition dependent upon irritation of some of the branches of the fifth nerve; in elderly persons it is often associated with degeneration of the blood-vessels; and in the young it is sometimes seen with perverted states of nutrition, and it ceases when these are overcome. Furthermore, tic has absolutely nothing in common with acute, humoral, Sydenham's chorea, nor with degenerative, parenchymatous, Huntington's chorea, and the term chorea should never be thought of in connection with this disease. Finally, tic being in a majority of instances a degenerative neurosis, it conforms in occurrence, in development, in progression, in obstinacy, and unresponsiveness to treatment with other diseases of degeneracy. The form of treatment of greatest avail is like that which has been shown to be of service in the class of diseases of which it is a type. The same principles should guide us in the treatment of tic as in the treatment of hysteria, of epilepsy, and of congenital defects in general, and in my experience the salts of copper and silver, when given in comparatively large doses and for prolonged time, while the bodily health and the general morale are cared for, are more efficacious in the degenerative form than other therapeutic measures.

CHAPTER XXXI.

THE TREATMENT OF MIGRAINE.

MIGRAINE—often called megrim, hemicrania, sick, bilious, or blind headache—is a degenerative neurosis, whose most constant and characteristic symptom, paroxysmal headache, usually confined to one-half of the head, occurs during the prime of life. Like all other degenerative neuroses, practically nothing is known of its etiology, save that it is hereditary in more than one-half of the cases. When direct inheritance cannot be traced, search of the ancestral and family relationship will often elicit a history of the existence of some other neurosis of a degenerative type, such as epilepsy, hysteria, tic, periodical inebriety, or rudimentary neurasthenia. For instance, I have at present under observation two sisters, aged respectively thirty-two and thirty; one has epilepsy, the other migraine. It is about as common in males as in females, and it chooses its victims from all walks of life. The wage-earner, the scientist, the statesman, the man of letters and of leisure, all furnish their quota of cases. Many men eminent in their callings and professions have studied the phenomena of the disease subjectively and objectively as it has been revealed in themselves, and this accounts for the widespread belief that the disease is most common in those of great intellectual possession. The immediate antecedents of an attack of migraine and the associated symptoms which go to make up the phenomena of a paroxysm are: factors contributing to fatigue, depression, enervation, and exhaustion of the soma and the psyche.

Symptoms.—The paroxysms of migraine occur with great irregularity. Some patients are so fortunate as to have only one or two attacks a year; in others they are of such frequent occurrence that the patient scarcely has any time of complete freedom from the attacks and their consequences. The headache is usually preceded by symptoms which the patient learns to interpret as heralders of an attack. These may be: general depression without attributable or apparent cause, uncontrollable inclination to yawn and gape, an indescribable feeling of confusion in the head, noises in the ear, restless sleep disturbed by disagreeable and terrorizing dreams, obscuration of vision by flashes of light, phantasmagoria, and patches of obscurity of changeable shape and position in the visual field known as scintillating scotomata, and occasionally by more or less complete transient unilateral amblyopia. The visual phenomena are more often ancillary, while the others may exist for some hours before

the attack. In rare instances the attack is preceded by a feeling of well-being, such as increased bodily tone and considerable mental exaltation. The preliminaries of migraine have often been likened to those of storm in which the massing of the clouds, the obscuration, and the violence of the elements gather their forces and concentrate, then the downpour occurs. After a variable period the rain gradually or suddenly ceases, the accompanying phenomena recede, and the whole world or the immediate environment seems brighter and clearer by contrast than it was before. Thus the pain and attendant phenomena of migraine may, after the warning given by the symptoms above enumerated, concentrate themselves to one side of the head, and be of intolerable severity and of protracted existence; but on the other hand they may be so insignificant and of such brief duration that the patient continues at his occupation or pleasure. As a rule the pain is on one side of the head, the left more often than the right. When it has more restricted localization it is likely to be of the forehead and temple. Very often, however, it is on both sides, or it may shift from one to the other. It is described differently by nearly every patient, depending largely on their descriptive powers and capacity for simile. As a rule, it is increased by excitation of any of the special senses, and by anything that disturbs the patient's body or mind. It is ameliorated somewhat, on the other hand, by darkness, stillness, quietude, and cessation of thought. After the attack the patient experiences an indescribable feeling of relief.

The phenomena that may precede, accompany, or follow an attack, aside from those mentioned above, are nausea, anorexia, vomit of the bile-stained contents of the stomach, great prostration, hyperæsthesia of the special senses, and general irritability. The local accompaniments, which are by no means so constant as the general, are paleness of the skin on one side of the face, enlargement of the pupil of the same side, increase of salivary secretion, narrowness and firmness of the temporal blood-vessels, contracted retinal blood-vessels, revealable by the ophthalmoscope, and lowered surface temperature over the pale areas of the face —phenomena that can be produced artificially in man and in animals by irritation of the cervical sympathetic. When these symptoms are accompaniments of the headache, the name of angiospastic migraine is given to it. Such attacks are sometimes attended by transient motor aphasia and slight motor paresis of one-half of the body, and very rarely transitory paralysis of one oculomotor nerve. In other cases phenomena occur that may be produced in the skin of the face and ear, pupils, and salivary glands, by section of the cervical sympathetic, such as redness of the skin, dilatation and pulsation of the temporal arteries, elevation of surface temperature, unilateral facial hyperidrosis, narrow pupil. Attacks thus attended are called angioparalytic migraine. They are extremely rare compared with the angiospastic variety. When the attacks are pre-

ceded and accompanied by subjective sensations that can be referred to the eyes, they are called ophthalmic migraine, although visual defect has very little, if any, relationship to their occurrence or causation. An attack of migraine lasts from a few hours to several days, and as a rule ends gradually, often attended by vomiting, copious evacuation from the bowels, and occasionally by profuse perspiration or diuresis. Then after a deep, protracted, lethargic slumber, the patient emerges with a feeling of renewed vitality and ambition. Attacks, however, always leave a memory of pain and anguish which prompts the individual to scrupulously guard against what he believes to cause or precede an outburst.

The course and outcome of the disease are the same as in most of the degenerative neuroses. Left alone, their most striking manifestations have a tendency to increase in severity and frequency. Unlike acquired diseases, they have no inherent tendency to grow less or to disappear. Occasionally the disease phenomena seem to undergo a transformation, and appear as vertigo, gout, epilepsy, or other paroxysmal condition. Dana has recently reported a case in which the transition from migraine to vertigo characteristic of pseudo-Ménière's disease was very striking, while the association of migraine and epilepsy is unfortunately not very rare.

Treatment.—The treatment of migraine may be considered under two headings: (1) the treatment of the patient or the disease, and (2) the treatment of an attack. To the patient himself the latter seems by far the more important, but the physician knows that more can be done to shape the course of the disease and to diminish the totality of suffering by care of the patient in the interval of the attacks than by any amount of medication at the time of the paroxysm. The treatment of the migrainous patient should be begun, like that of all other diseases of degeneracy, before the patient is born. I cannot here revert to the duty of the physician, whose advice may be asked concerning marriage for those who are burdened with hereditary and familiary taint, further than to say how difficult it is to act the part of satisfactory guide. (See Part I.) The physician should always confine himself to showing the way, and not insist upon accompanying to see that his decision is respected. Considering the indebtedness of the world to migrainous persons, it would be an assumption on the part of the physician to advise against marriage, for he might be depriving posterity of a Sir John Herschell, a Du Bois-Reymond, or a Wollaston. Nevertheless, if he be more altruistic than utilitarian, he must be true to his ideal and prevent suffering whenever possible. The education of children born of migrainous parents should be conducted along a plan similar to that of those who inherit a tendency to that profound neurosis known as hysteria. In brief, every effort should be bent to make such patient a resistant, vigorous, healthy man or woman. They

should neither be subjected nor allowed to subject themselves to the forcing, crowding processes, conglomerated under the name of education or accomplishment, that the modern boy and girl has to go through at the present day. When the age is reached that such a person must make a decision as to his future occupation or preparation for destiny, the physician, if given an opportunity, should again be ready to act the part of the sign-post. It is unnecessary to say that an active life out-of-doors contains much less potentiality of migraine than a sedentary life within doors. The perniciousness of alcoholics, tobacco, tea and coffee, overeating, sexual aberrations and excesses, late hours, and strife of all kinds, should be diligently inculcated and constantly kept before the patient until he comes to recognize their importance. The patient should learn early that freedom from pain stands in more or less definite relationship to mental equanimity, evenness of disposition, uneventfulness of life, and normal state of the digestive apparatus, and that he should strive for these. He should so arrange his time that at least ten hours may be given to sleep, while two or three of the remaining twenty-four should be spent in the open air, taking some sort of exercise that will increase the neuromuscular tone and maintain a high degree of nutrition. This may be impossible for the great majority of bread-winners, especially women, in whom, unfortunately, migraine is not rare; but in these cases some shift must be made, either by use of hydric procedures, massage, gymnasium practice, or by shortening the day's work, to compensate for the health-giving indulgences above mentioned. It is in this class particularly that so much can be done by teaching the patient that worry, anxiety, and anticipation of want, or conviction of inability, do far more harm than the actual fulfilment of their daily duties and labors.

Supervision of the diet and regulation of the bowels are of themselves often very influential to diminish the frequency and severity of the attack. As a rule, a mixed diet, vegetables predominating, with comparatively little meat, especially red meat, supplemented by milk, combined with an alkali, such as bicarbonate of sodium, commercial or natural Vichy, is most suitable. Whenever possible the bowels should be regulated by the admixture to the diet of substances that are known to have a laxative effect, and by the use of abdominal massage, and gymnastics that strengthen the walls of the abdomen. Simultaneously the tonus of the intestines is increased by the use of vegetable laxatives with belladonna or nux vomica, cold-water injections, and sitz baths. The mistake should not be made of giving salines, such as sulphate of soda and Carlsbad salts in large doses, or other substances that deplete the system. The patient should be subjected to the most scrutinizing medical survey, and any departure from normal, either in the organs of the body or in the tissues, repaired or attempt made to overcome them. Occasionally such scrutiny will reveal abnormalities of the eyes, ears, cavities of the

head, or of the uterine organs, which may or may not have any bearing on the neurosis itself or on the frequency of its most prominent manifestations. They, nevertheless, should be overcome, if possible, and for the reason that all physical shortcomings act as a drain upon the general health. The physician who seeks the immediate antecedent of an attack, be it intoxication from without, such as poisoning by one of the metals, overeating, especially of meats, auto-intoxications, uric acid, fatigue, etc., and adopts a plan of treatment to eliminate or counteract it, is much more worthy of his hire than he who neglects to do so. It is usually unnecessary to tell migrainous patients how they shall live, what they may do, and what they must avoid; experience is by far a better teacher than rule of thumb. They quickly learn the disastrous effect of late hours, crowded rooms, indiscretions of diet, overexertion, and excesses of different kinds, and avoid them. If migraine is associated with such states as anæmia, displacements or disease of the uterus, chronic middle-ear disease, disease of the nasal passages, dyspepsia, etc., these require special treatment. It is when the latter exists that lavage of the stomach and intestines is often useful. The valerianate of menthol in two- to five-grain doses has recently been recommended. In every case the digestion and state of the intestines should be inquired into. When the alimentary tract is disordered, a course of Carlsbad water may be of service. The following prescription will often give good results:

℞ Caffeinæ citratis,
Menthol., ... ää gr. viij.
Quininæ, ... gr. xv.
M. ft. caps. One every two hours.

It is unnecessary to speak in detail of the use of such measures as hydriatics, massage, gymnastics, and even electricity, for the purpose of increasing the patient's general nutritional tone and resistance. Practically they have the same application here as they have in neurasthenia, even in the acquired forms of the latter disease. These agencies have no specific virtue in migraine, and the claims of enthusiasts for the unfailing efficacy of one or other of them in the treatment of migraine are not alone a travesty on physiological therapeutics, but an epitome of such enthusiasts' ignorance concerning the genesis of the disease and interpretation of its phenomena. They are all of service, and for the reason that they not alone increase the patient's vital force, but they give him a feeling of confidence that something is being done for him, the effects of which are tangible and beneficial. No more is it becoming for those who do not fully recognize the benefits to be had from the methodical use of these measures to decry them. Their place in the therapeutics of migraine is no exalted one, but they fill an unoccupied niche. Having said this, I do not feel impelled to recount in detail the modes of applying water

or of utilizing massage, or of indulging in gymnastics. A word, however, in regard to electricity is necessary. Galvanization of the cervical sympathetic has probably more merit theoretically than any other procedure. But we have seen from the brief description of the symptomatology of migraine that the sympathetic phenomena may be those of irritation, or of relaxation, and the form of electricity that is good for the one cannot surely be good for the other. Empiricists may contend that the irritating or negative pole should be used in the angioparalytic variety, and the cathode or sedative pole in the angiospastic variety; but experience will soon convince that they speak not out of the fulness of their knowledge. As a matter of fact, electricity in the shape of galvanism to the cervical sympathetic or to the head, faradism in the shape of general faradization, or the application of the rapidly interrupted current from a long, closely wound coil, the static douche or sparks—in short, any variety of electrical application—has its entire usefulness in the treatment of migraine in improving the patient's general health, and in inspiring him with a feeling that something beneficial is being done for him.

The drug administration under this caption, namely, the treatment of the patient, should consist in giving simple bitters to counteract anorexia, alkalies or acids, dependent upon the reaction of the contents of the stomach, laxatives to overcome constipation, iron, arsenic, and quinine as tissue reconstructives, and the fulfilment of the other requirements that may be apparent or discoverable in each individual case.

There are a few drugs that undoubtedly have a decided effect in diminishing migrainous potentiality. Among these the first place is by common consent given to the bromides, originally suggested by Liveing, who wrote so illuminatingly of this disease, and brought into wide usage by the recommendation of Charcot. The etiological and clinical resemblance which the disease has to epilepsy suggested, no doubt, the usefulness of the most important anti-epileptic medicament in migraine. The mode and plan of its administration, as well as the rules for the avoidance of its injurious effects, are the same as those given for epilepsy. The dose depends upon the idiosyncrasy of the patient more than upon any other condition; and this must be determined by experience. The selection of any particular salt of bromine is of no importance, one being about as serviceable as another. After the patient's dosage has been determined, the quantity, be it a scruple or a drachm, should be administered in large quantities of water, plain or alkalinated, at bedtime. As a rule it is not advisable to give it during the day. It should be given for a prolonged time, provided the patient does not lose weight, and there is no disturbance of digestion and nutrition which is not easily combated. When these occur, the measures that are serviceable in combating the phenomena of bromism should be utilized. The administration of the bromides is almost invariably followed by a lengthening of the inter-

vening period of health and by diminution in severity of the headache and ancillary migrainous phenomena.

Treatment of an Attack.—During the attack some pain-reliever must be given in sufficient doses to relieve pain, especially in severe cases. Before the discovery of the modern analgesics, the physician had very little choice about using morphine. The patient demanded it, required it, and got it, and very properly so. Oftentimes, even yet, it is necessary to administer morphine, either by the rectum or subcutaneously, and when used under control of the physician there is little danger of establishing the morphine habit, providing, of course, that the patient is not in a status migrainosus. As a rule, however, sufficient relief to enable the patient to get through an attack is obtained from phenacetin, antipyrin, antifebrin, one of the salicylates, caffeine, cytisin, lactophenin, etc., or combinations of them. A useful prescription is:

℞ Phenol salicylate, ... gr. x.
Caffeine salicylate, ... gr. ij.
Phenacetin, ... gr. x.
To be taken with hot milk, or hot water and whiskey.

This formula seems to be particularly serviceable in so-called ophthalmic migraine, associated with pallor of the face. On the other hand, when there are flushing of the face and the other accompaniments above mentioned, I have used a capsule containing camphor, valerianate of menthol, and salicylate of caffeine, of each two grains, the dose being repeated every hour for three doses; then every four hours, if required. It is impossible to give in detail all the combinations of these pain-relievers that may be used with benefit. Patients vary so in their susceptibility to these drugs that it requires some experimentation to find the most serviceable one. Antifebrin given in five-grain doses and followed by draughts of pure black coffee has been most serviceable in my own experience. It is well to bear in mind that when it is necessary to give one of them hypodermically, antipyrin is the most satisfactory, although it has a tendency to derange the digestive system.

Migraine attended by symptoms of vasomotor spasm is often promptly benefited, although the attack is not materially shortened, by the administration of one of the nitrites, the inhalation of nitrite of amyl being most eligible. The drawback to its use is that its action is very evanescent. In this respect nitrite of sodium in one-grain doses is much superior. Gowers, who has been a persistent exponent of the usefulness of this class of remedies, suggests the administration of fractional doses of nitroglycerin, given every fifteen minutes until the physiological action is manifest. No dogmatic statement can be made in regard to the efficacy of the nitrites, but a faithful trial should be made of one or all of them in every case of migraine attended by angiospastic phenomena.

When the concomitant vasomotor manifestations are of a paralytic variety, which, as has before been said, is extremely rare, it has been advised to give ergot, but my experience has been that very little reliance can be placed upon this drug. On the other hand, I have found prompt relief, personally and in a number of patients, by light manual compression of the carotids, or by a folded handkerchief pinned tightly around the neck. The application of an ice-bag to the head is also sometimes useful and soothing.

The autotoxæmic theory of migraine has been more widely accepted, the writer ventures to believe, than it deserves. Numerous plans of treatment based upon this theory have been devised and promulgated. There can be no doubt that there is a state of profoundly disordered function of the digestive tract during an attack of migraine. If the contents of the stomach or intestines, removed during an attack, are examined chemically they will probably be found to contain a small amount of toxic substances. But this perversion of function and the immediate consequences are caused by the profound disorder of the sympathetic nervous system, which is at the bottom of the attack of migraine; they are the results, not the cause, of the migraine. No doubt the digestive disturbance and its entailments acting upon an already overwhelmed economy will help to retard the establishment of equilibirum. Therefore measures should be taken to overcome the effects of such intoxication and to counteract the formation of the toxic substance. If this can be accomplished by having the patient drink copiously of hot water, by the administration of a soapsuds enema, or by lavage, these should be used. They are aids only in facilitating the restoration of neural equilibrium.

In the majority of cases it is unnecessary to enjoin absolute rest and supreme quiet, with freedom from every form of irritation and excitement, during an attack. The patient voluntarily embraces these measures, for one attack is sufficient to apprise him of the comparative comfort they give. After a severe attack the patient should receive the same attention as in epilepsy. The inroads which the suffering has made upon his strength and morale should be combated by the use of readily absorbable and highly nutritious food, and preparation should be made to strengthen any vulnerable points in the general health previous to the occurrence of the next attack.

CHAPTER XXXII.

THE TREATMENT OF CHOREA.

The term chorea means literally a dance. When used without qualification, Sydenham's chorea, or St. Vitus' dance, is always meant. Sydenham's chorea is an infection or a post-infectious intoxication, which occurs predominantly in children and is characterized by involuntary, uncontrollable, abrupt, bizarre dance-movements of the extremities, face, and occasionally of the trunk muscles; myasthenia; and mental sluggishness. The disease is a self-limiting one, and usually runs its course in from two to four months. It has nothing in common with chronic, degenerative chorea, or Huntington's chorea, save one symptom, the choreic movements or twitchings. It has absolutely no relationship to the tic neurosis which is accompanied by manifold choreic movements, nor to the so-called habit choreas.

For purposes of convenience the choreiform diseases may be classified as follows:

I. *Acute Infectious Chorea; Sydenham's Chorea.*—A toxic or infectious disease manifesting its most pernicious activity on the central nervous system and occurring predominantly in an acute form before puberty, but occasionally in adult life. Rarely is it subacute or chronic. Clinically, there are two varieties: the twitching form and the limp form.

II. *Chronic Degenerative Chorea; Huntington's Chorea.*—An hereditary, progressive degeneration of the cortex of the brain, characterized by symptoms of mental and physical irritability, followed by mental decay and physical exhaustion.

III. *Electric Chorea; Dubini's Chorea.*—An acute choreic affection pursuing a progressive course and terminating in death in upward of ninety per cent of the cases. The disease is endemic to northern Italy, and probably depends upon some specific infection, though it may be pellagrous or malarial.

IV. *Tic Choreas.*—Dance movements symptomatic of the degenerative neurosis known as tic, manifesting themselves as laryngeal chorea, diaphragmatic chorea, saltatory chorea, gesticulatory chorea, festinating chorea, and procursive chorea.

V. *Habit Chorea.*—A condition whose pathogenesis is indicated by its name. It is sometimes an occupation neurosis.

VI. *Senile Chorea.*—A choreiform disorder occurring during the later part of life, dependent upon degenerative changes in the brain inci-

dent to senility. The disease runs a chronic course and never ends in recovery. It is to be differentiated from chronic Sydenham's chorea, which occasionally occurs in the senilium.

VII. *Secondary Chorea.*—Irregular movements secondary to and symptomatic of gross organic lesion of the brain.

The separation of acute Sydenham's chorea from the different varieties of tic and from the hysterical choreas seems to have been attended with much difficulty, for even nowadays we read of hammering chorea, laryngeal chorea, diaphragmatic chorea, etc., discussed under the treatment of Sydenham's chorea. It is now generally admitted that these latter conditions are manifestations of the tic neurosis, and that acute Sydenham's chorea is a blood disease whose peccant activities are manifest principally on the cortex of the brain to produce many symptoms, the most striking of which are choreic movements. Just as it would not be considered scientific to discuss lung fever when writing of typhoid fever, so is it illegitimate to speak of chronic degenerative chorea, tic choreas, and habit choreas, when discussing Sydenham's chorea. Yet lung fever and typhoid fever have vastly more in common than have any two of these diseases. The most interesting features of Sydenham's chorea are its pathogenesis and causation. Very little is known of the former, and not sufficient of the latter, although much energy has been expended in an endeavor to settle many of the mooted points.

The following remarks on the etiology of this disease are based on one hundred cases recently studied, and not on preconceived ideas or previous knowledge.

The first point worthy of consideration is the age of the patients. The youngest patient was three, the oldest twenty-five years. The average age at the time of the first attack was nine years. The following table shows the ages of the patients in reference to the school period:

	Females.	Males.	Total.
Ages 1 to 7	6 = 6 per cent.	5 = 5 per cent.	11 per cent.
Ages 7 to 15	45 = 45 "	32 = 32 "	77 "
Ages over 15	8 = 8 "	4 = 4 "	12 "
Total	59	41	

Tabulated according to decades the figures are as follows:

First decade,	26 females.	24 males.
Second decade,	31 "	16 "
Third decade,	2 "	1 male.
Total,	59 "	41 males.

Examination of these statistics shows that the school period embraces

upward of seventy-five per cent of all the cases, and that the first ten years of life claim fifty per cent of the cases. Chorea occurs predominantly between the seventh and fifteenth years. Although no instances of Sydenham's chorea in advanced life are cited in these statistics, such cases are encountered occasionally.

Sex is an important etiological factor of chorea. Of these 100 cases, 41 were males and 59 were females, the ratio being therefore about as 2 to 3. This does not correspond with the figures of most writers. For instance, Sée gives the proportion as 26 to 74, Sturgis 24 to 76, and Wollenberg, one of the most recent writers on the subject, 28 to 71. Some interesting facts are obtained from an investigation of the nationality and race of our patients. Seventeen per cent of the patients were foreign born. Of these Russia contributed 8, Germany 3, Austria-Hungary 3, and England 3. Thirty-seven per cent of the cases were of foreign extraction, the vast majority being either German or Irish. This preponderance of the Russian in the foreign-born statistics and of the Irish and Germans in the foreign-extraction statistics, is very easily explained. The Russians emigrate to this country with families of small children, while the vast majority of Irish and German emigrants are single. There were no negroes amongst the 100 cases. A fact worthy of note is that 27 per cent of the cases were Jews. This is particularly remarkable in view of the fact that the clientèle of the clinic is not largely Semitic. The predisposition of the Jew to the so-called functional nervous disorders is very generally recognized.

The relationship of chorea to season has, during the past few years, been carefully studied. Twenty-nine per cent of these cases occurred in the summer, 29 per cent in the spring, 26 per cent in the winter, and 16 per cent in the autumn. The greatest number of cases occurred in July and March, and the minimum number in October. No relationship in the occurrence of chorea to hygrometric conditions could be established.

That chorea has some relationship to overwork in school and particularly at the time of examinations, is mentioned by most writers, although my own observations are non-committal on this point. It may be that the frequency of chorea in the summer may be in some way related to school examinations. Very little information concerning the occurrence of chorea in children of different stations in society is to be got from a study of dispensary patients. Nevertheless, it is worthy of remark, that the vast majority of cases occurred in what may be called the better class of dispensary patients.

The important rôle played by heredity in the genesis of all so-called functional nervous diseases is well recognized by neurologists. Investigation undertaken to show the influence of heredity on the development of chorea, reveals that in the immediate and collateral ancestors 27 per

cent were neuropathic, 21 per cent rheumatic, 12 per cent choreic, 2 per cent cardiovascular, and 2 per cent tuberculous. In 35 per cent of the cases the family history was negative. These figures are very much at variance with those of other writers. Eulenburg, for instance, states that a neuropathic taint was found in the majority of his cases; and Koch found that about eighty per cent of his cases showed a neuropathic family history. Sturgis, on the other hand, could elicit such a history in only about twenty per cent of his cases. Direct choreic or similar heredity can rarely be elicited. When it can, it may be considered accidental.

The influence of rheumatism on the development of chorea is still a debatable topic, despite the fact that an enormous amount of care has been expended in an endeavor to prove the interrelationship of these two conditions. I have long been of the opinion that the relationship of chorea to rheumatism is more important than might be inferred from the statistics of some recent writers. The discrepancy in the statistics of different writers in regard to the influence of rheumatism can be explained, in part, by the different meaning or interpretation put upon the term rheumatism by different writers. Without in any way attempting a definition of rheumatism, and without reference to its pathogeny, it may be said that three types of rheumatism are distinguished: 1st, tonsillar, or anginous rheumatism; 2d, articular rheumatism; and 3d, cardiac rheumatism, including rheumatic pericarditis, endocarditis, and myocarditis. A history of repeated attacks or a series of attacks of tonsillitis occurring during the rheumatic seasons and yielding to antirheumatic medication has been looked upon as evidence of a rheumatic constitution. It was found that tonsillar rheumatism occurred in 23 cases, articular rheumatism in 16 cases, and cardiac rheumatism in 32 cases. In 1 case all three varieties were present. Fourteen cases showed the tonsillar and cardiac varieties; 5 cases the articular and cardiac; and 2 cases articular and tonsillar. There were also 4 cases of cardiac involvement in which no rheumatic history could be obtained. These statistics seem to show that there is a definite relationship between the rheumatic dyscrasia and the occurrence of chorea. It is possible that chorea is a metarheumatic manifestation. During the occurrence of rheumatism toxic substances are developed in the blood, and these act deleteriously upon the nervous system, which may be more or less unstable through heredity, to produce the well-known clinical picture of Sydenham's chorea.

Careful examination of the heart in chorea shows the frequent occurrence of hypertrophy and dilatation, with accentuation of the first apical and second pulmonic sound. These it is believed are very frequently the indicators of a previous rheumatic dyscrasia. Cardiopathies may exist without the occurrence of cardiac murmurs, and a careful examination by

percussion is oftentimes more serviceable to show the real state of affairs than is auscultation.

Some writers maintain that chorea occurs sequentially to infections, *i.e.*, that it is a secondary disease. These statistics are opposed to such a view. No disease, save rheumatism, seems to have particular causal relationship to chorea. In none of the cases did there seem to be any relationship to the eruptive diseases of childhood.

The attributed exciting causes of chorea are some variety of psychical trauma, such as fright, acute worry, and highly wrought anticipation. Very rarely does it seem to be gastro-intestinal irritation, as from the presence of worms, and strain of a special sense organ, such as the eye. An examination of the cases relative to the attributed cause as given by the parent or patient shows as follows: Fright, 16 cases; injury, 9 cases; rheumatism, 9 cases; overwork, 4 cases; excitement, 3 cases; and bilious attack, whipping, school examination, excessive rope-jumping, simple fever, an attack of grippe, each 1 case. In one patient the original attack and the relapse were directly traceable to an attack of malarial fever. Temperament has been spoken of as an etiological factor, but from a study of these cases I am led to the belief that it is not a matter of any considerable importance. That chorea is more common in excitable children, as suggested by Osler, has not been corroborated by this study. The rarity of reflex excitation, masturbation, imitation, eye-strain, and the like, in the causation of chorea, either predisposing or exciting, is shown by the fact that in none of these cases could such history or relationship be traced.

Chorea is a disease that is particularly liable to recurrence or relapse. Forty-five of the 100 patients had more than one attack. Of these, 15 were males and 30 females. The relationship of rheumatism to the recurring attacks was practically the same as that given for the original attacks. Sixteen of the 45 individuals who had recurrent attacks had some variety of cardiopathy. The recurrences were rather evenly distributed amongst spring, summer, and winter. The average age of those who had relapses was $11\frac{1}{3}$ years, which is seen to be considerably higher than the average age of the original attack. The average time between the original attack and the recurrence was 20 months, the shortest interval being 2 months, the longest 9 years.

It is well known that a peculiarly severe form of chorea occurs occasionally during pregnancy, especially in primiparæ. It is impossible to estimate the frequency of this variety of chorea, but that it is not common may be inferred from the fact that no case of this kind has been seen in the clinic during the past six years. Chorea gravidarum is more likely to occur in those who have previously had chorea and in rheumatic persons. Although not necessarily of a severe clinical type, it is often accompanied by mental symptoms of a maniacal character, elevation of

temperature, and great physical agitation. Chorea of adults is always a more serious disease than chorea of children; and the variety under discussion is one of the gravest varieties.

The significance of an attack of chorea is more than mere tenure of the symptom complex indicates. In the first place the disease occurs more frequently in those whose heritage is neuropathic, in those whose bringing up has not been such as to promote self-restraint, but rather permit the indulgence of passions and appetites, and in those who are unamenable to disciplinary measures. An attack of chorea, be it ever so slight, in a way points to the existence of a neuropathic diathesis, and indicates that the possessor is more honestly entitled to succumb to the harassments of life than are his more stably organized fellows. This should prompt the endeavor to make the treatment more far reaching than through the weeks when dance movements are present.

Treatment.—The treatment of chorea is a very simple matter. The vast majority of patients would recover just as quickly if they were put under the proper disciplinary, hygienic, and dietetic measures, as they do when subjected to the most orthodox plan of treatment. Rest is by far the most important measure in the treatment of chorea, and the more complete the rest the speedier the cure. Choreic children should be at once taken out of school and the parents urged to put them to bed, and keep them there if possible. It is difficult to convince parents of the necessity of this seemingly too heroic measure, and much more difficult still to keep the patient in bed willingly or unwillingly. The physician should make the closest compromise possible. A measure of what is desired in this direction can be had by having the patient stay in bed one or two hours later in the morning than is habitual and lie down for an hour or two in the afternoon. No infringements of the rule that choreic patients should be in bed before dark is to be tolerated. Many of the patients are in a run-down, mentally overwrought condition, the result of the rheumatic dyscrasia, improper nutrition, and prolonged application to studies. Consequently, rest and freedom from all sorts of excitement, combined with careful attention to the diet, is the most rational prescription.

Children who have been accustomed to a mixed diet should be put at once upon an exclusive milk diet, which is to be given up to the point of tolerance. Older children and young adults may be allowed a mixed diet which contains a comparatively small amount of animal food. In almost every case the bulk of the food should be milk and cereals. Fatty foods have never seemed to me to be of particular service. Sweets and farinaceous foods should be eliminated because of their liability to cause flatulency and thereby to increase cardiac palpitation. The digestive apparatus is not usually deranged, but when it is, measures should be taken to counteract excessive acidity, fermentation, and constipation. A cold

wet compress over the abdomen, known as the Neptune girdle, has not only a beneficial effect upon the alimentary tract, but very often exercises a soothing effect, which aids physical and mental rest and sleep. Other hydriatic measures may be used to overcome motor unrest, and to contribute to the maintenance of nutrition. The patient on arising should be made to stand in a tub or basin of warm water, while water of from 75° to 60° is dashed on the spine from the hollow hands of the mother or an attendant, or thrown against the spine from a dipper or pitcher, and then followed by vigorous rubbing, with the hand, a flesh brush, or a coarse towel. After such an ablution the little patient usually feels very much refreshed and invigorated. When the motor unrest is very great, salutary results are often had from the use of the wet pack applied before retiring. The moderately cold wet pack is better in this respect, particularly if the patient is asthenic, than the warm pack. The latter, however, is preferable in the beginning of the disease, and especially when the agitation is very great. The pack is not only soothing to the patient but contributes to refreshing sleep. It is far better than hypnotics, and has the advantage of not being followed by disagreeable after-effects. After the first one or two applications children do not rebel against it; in fact, they enjoy it.

The medicines that are of service in chorea are few in number. This bespeaks their real value. The most important drugs are arsenic, antipyrin, quinine, exalgin, iron, and the bitter tonics. Possibly the bromides and chloral should also be mentioned, for, although they have no antichoreic properties, they are often beneficially used as symptom medicines. It is difficult to estimate the real value of arsenic in chorea, even though tradition and experience speak so loudly in its favor. Most writers agree that it has an important influence in shaping the course and in modifying the severity of any attack. This opinion the writer shares, though not with great enthusiasm, for it has already been said that under favorable conditions the vast majority of cases recover as surely and promptly without any medication. Arsenic may be given in the shape of Fowler's solution or the arseniate of sodium. In the latter form it has less tendency to disorder the digestion, and it seems to be quite as beneficial. Seguin taught that arsenic should be given in large doses, even to the production of such toxic effects as puffiness around the eyes, epigastric distress and vomiting, and lacrymation, but I am firmly of the opinion that as soon as such symptoms appear the drug should be withheld until the poisonous symptoms disappear.

Exalgin is a potent drug to lessen the severity of the choreic movements, and it also seems to shorten an attack. The serious objection to its use is that it causes profound hæmolysis. Its effects upon the patient's appearance and vitality are manifest very promptly, and to one unaccustomed to its use they may seem very alarming. These symptoms

are paleness of the skin, bluish appearance of the extremities, lowered surface and general temperature, and, if pushed to a greater degree, epileptiform convulsions and symptoms of collapse. The drug may be given in doses of from one-half grain to three grains, repeated every five hours, to children under ten years of age. It should always be given in conjunction with large doses of some absorbable preparation of iron. Exalgin is of greater service in the early stages of an attack than later in the disease. Were it not for the profound anæmic and collapse symptoms which it causes, the drug could be recommended more warmly, for, in truth, it is nothing less than astonishing how quickly it mitigates the severe motor manifestations of the disease.

Antipyrin, quinine, and the salicylates have all been strongly recommended in the treatment of chorea. Satisfactory results often follow their use. It is supposed that quinine owes its beneficial effect to its action on the blood in contributing to hæmagenesis. The salicylates are given on account of their supposed antirheumatic effects, and when there are evidences of any of the clinical varieties of this dyscrasia, they should be administered. Some writers have spoken of their value in contributing to intestinal antisepsis. Speaking in general terms, intestinal antisepsis is a myth. If evidences of intestinal fermentation exist, there are many more efficacious ways of counteracting it than by giving the salicylates.

A combination of chloral and bromide is often of service when the motor unrest is extreme, particularly if it is associated with wakefulness. They should never be given continuously, because of their malign effect on the blood. If insomnia is sufficiently pronounced to require special medication, it can easily be combated by hydric application or by the administration of small quantities of trional with hot milk.

Bromide of camphor in from two- to five-grain doses in capsule form has recently received warm recommendation in the treatment of chorea. After considerable trial I cannot say, however, that I have found it of any particular value.

The mental disturbances of chorea do not call for special medication. The measures taken to counteract general asthenia and to combat excessive tissue metamorphosis will suffice to overcome them. It should never be forgotten that chorea is a general blood disease in which the brunt of the hæmic deterioration is borne by the central nervous system, and that measures taken to overcome the general conditions will relieve proportionately the local manifestations.

Chorea occurring with pregnancy is usually much more severe than the acute chorea of early life. It demands active and vigorous treatment from the start. Otherwise it will result in such a condition of bodily weakness that the patient will either abort spontaneously or the necessity of terminating pregnancy will become paramount. In these cases no difficulty is experienced in getting the patient to take to her bed; but

often the question of feeding becomes a very important one, as it is not infrequently associated with intractable vomiting. The same measures should be used to overcome this symptom that are of service when it occurs with pregnancy uncomplicated with chorea. Apart from this, the treatment is not unlike that of simple chorea. If the severity of the symptoms is mitigated promptly, the patient may be allowed to resume her ordinary duties, and the prospects are that complete recovery will follow. If the symptoms are so severe that the life of the patient is in jeopardy, there should be no hesitation or delay in removing the contents of the uterus.

Chorea in the adult male and chorea of advanced life do not require different treatment from chorea of the young, unless it is associated with organic disease, such as of the blood-vessels.

It has already been said that chorea is very liable to relapse, and a knowledge of this fact should prompt the physician to adopt measures that will tend to prevent the recurrence of this neurosis, particularly in the spring and summer, when the majority of cases occur. Bearing in mind the predisposing and exciting factors of chorea, it will readily be seen that these indications are encompassed by attention to the general nutrition, proper use of hydriatics and exercise, interdiction of excessive mental application, and by the maintenance of intelligent mental and physical discipline. When the occurrence of the disease seems to have a definite relationship to rheumatism, the rheumatic diathesis should be particularly counteracted.

It has been said that chorea is a self-limiting disease. There are exceptions to the rule, and many of these are found in the choreas occurring in late adult life. Patients who do not recover after a lapse of the usual time require somewhat different treatment from the acute case. The treatment to which they are more or less amenable is similar to that which is of benefit in neurasthenia. Medication is the least important factor, although beneficial results are sometimes seen to follow the administration of potassium iodide in relatively small doses, one of the preparations of zinc, such as the bromide or valerianate (two to eight grains of the former given in syrup and from one to four grains of the latter for an adult) combined with general tonifying medication. Electricity has been recommended, and it may, by its appeal to the mind of the individual, have a quieting and beneficial influence, but aside from this it has no therapeutic value in the treatment of this disease. Often the application of the actual cautery to the nape of the neck and the upper part of the spine makes a great impression upon the patient and favorably influences the course of the disease. In every case of this kind the liability to the element of hysteria and habit should be kept in mind, and when there are evidences of either of these conditions, the value of isolation and other disciplinary measures not forgotten.

CHAPTER XXXIII.

THE TREATMENT OF PARALYSIS AGITANS.

Paralysis agitans, commonly known as Parkinson's disease, is a disease without known anatomical foundation, characterized by tremor of one or all of the extremities, by rigidity and lessened mobility of the voluntary muscles which cause a characteristic attitude and gait, by vasomotor phenomena and amyosthenia. Despite the many careful investigations of the nervous system that have been made by the aid of modern methods, the nature of the disease is still unknown. Although classified as a functional nervous disease, pathological changes are almost invariably found in the central nervous system after death, especially if the disease has existed for a long time.

It is a disease of late maturity. The vast majority of cases occur between the ages of forty and fifty, but a number of well-authenticated cases have been recorded of patients with this disease before the twentieth year of age and after the sixtieth. Women are afflicted less often than men. It is more common in the Anglo-Saxon and Celtic races than in the Latin and Oriental peoples. Practically nothing is known of its causation. Now and then its development has been more or less immediately preceded by some mental or physical strain, such as overwork and indulgence in excess, and by fright, trauma—oftentimes the two combined, the former being far greater than the latter, by exposure to cold and wet, and other enervating and depraving influences. These are the factors that are apparent in many forms of nervous diseases, and they probably have no other significance than their perniciousness in lowering vitality. Occasionally the symptoms of the disease occur more or less remotely in the wake of some infection, and rheumatism. Recognition of this fact has prompted many writers to theorize concerning the probable relationship of these diseases to the one in question and the manner in which the phenomena of paralysis agitans are brought about.

In order to estimate the attributed and apparent cause, the relative frequency, to determine the initial symptoms and mode of onset, and to learn the factors that influence the course of the disease, twenty-six cases, taken from dispensary, hospital, and private practice, in about equal proportion, have been studied.

The accompanying table shows the relationship of age, nationality, and heredity to the occurrence of the disease:

NATIONALITY.

Nation.	Males.	Females.
United States	2	2
Holland	1	
England	1	
Germany	3	2
Ireland	9	3
Austria	1	
Russia	2	
Total	19	7

AGE.

Decades.	Males.	Females.
Thirty to forty years	1	
Forty to fifty years	7	1
Fifty to sixty years	5	3
Sixty to seventy years	4	3
Seventy to eighty years	2	
Total	19	7

HEREDITY.

	Males.	Females.
Direct heredity	3	1
Indirect heredity	3	1
No heredity	9	3
Unknown	4	2
Total	19	7

The most striking feature in reference to nationality is the remarkable predominance of the Irish race. Very nearly one-half of all the cases were of this people. When we consider that the constitution of the clinic is not conspicuously Irish, it will readily be seen that this preponderance is not to be explained by accident. It may be that the Irish, being a very emotional race, are more vulnerable to the attributed exciting causes of paralysis agitans: shock, anxiety, worry, and depression. It is not improbable, however, that it is in part explainable by the entirely different mode of life which the people of this race have when they take up their abode in this country, as no one has pointed out that the Irish are particularly afflicted with paralysis agitans at home. In other words, it would seem to be as much environmental as inherent. Another peculiar feature of the statistics concerning the nationality of the patients is the relative infrequency of the disease in Irish women, contrasted with the women of other nationalities. For instance, the Americans and Germans furnish an equal number of men and women. Many German and French

writers maintain that there is very little relationship of sex to the occurrence of paralysis agitans. It will be seen that my statistics show that the occurrence of the disease is three men to one woman. Gowers gives the proportion in his experience as five men to three women. The disease occurs most often in the fifth decade, and gradually diminishes until the eighth decade. Two typical cases after the seventieth year, and one in the eighteenth year have been encountered.

The influence of heredity has been considered of not much importance, but in no less than four cases was there a straightforward history of direct inheritance. In one case the father had paralysis agitans, while the mother and a maternal uncle died with some form of paralysis. In a second case the mother had a disease similar to that of the patient, the shaking being particularly marked when she was excited. In a third case the father had exactly the same disease for the last eight years of his life, and it is thought a paternal uncle was similarly afflicted; while in a fourth case, that of a woman, the father and a paternal aunt had exactly the same disease. Naturally, this information was obtained only from the patient or the descendants of the patients, and is therefore liable to serious error. A very careful inquiry was made in every case on this point, with the above result, which is so at variance with the usual teaching on the subject that I am unwilling to accept it as absolute fact. A history of indirect heredity—that is, of manifestations of nervous or mental disease in the family—was found in sixteen per cent of the cases. Upward of fifty per cent of the cases gave neither direct nor indirect neuropathic history.

In regard to occupation, the statistics show that the patients were very evenly distributed among upholsterers, plasterers, gardeners, saddlers, engineers, printers, laborers, sailors, mill hands, promoters, journalists, clerks, merchants, and fancy workers. Neither the mentally harassed nor the physically overworked are especially liable to the occurrence of the disease. Workers out of doors develop the disease as frequently as indoor workers. The statistics further show that the disease is as likely to occur in one grade of society as in another. Of the seven women, four were married, two were widows, and one was single; while of the nineteen men, sixteen were or had been married, and three were single.

Inquiry to determine the alleged causes of the disease did not give satisfactory information. Only about thirty-five per cent of all the patients were able to give a distinct cause. The attributable causes were: 1. Shock attending the death of a beloved daughter. 2. Excessive and prolonged mental strain, incident to supporting a family. 3. Family trouble. 4. Constant exposure and becoming wet, incurred in occupation. 5. Contact of the hand with cold stone in winter, while employed in polishing marble. 6. An attack of grippe. 7. Fright; the sudden appearance of a strange black cat near her bed. 8. The discovery that

an unmarried daughter was pregnant. 9. Being knocked down by a vehicle, but without consequent physical injury. 10. Finding that all his savings had been lost. Thus it will be seen that the alleged causes are psychical or emotional trauma. It has frequently been stated that acute and chronic diseases of various kinds have a predisposing influence upon the occurrence of paralysis agitans. This statement is corroborated to a slight extent by this study. Of the six women, four denied any previous disease. One had had a fungoid growth removed from the uterus shortly before the occurrence of paralysis agitans; one had had chronic diarrhœa. A third patient had had yellow fever a great many years before the occurrence of the disease for which she came under observation. Of the men, one gave a history of a blow on the head, after which he had been delirious for three months; but this had occurred so long before the manifestations of Parkinson's disease that it could not possibly have had any influence. Another had had an attack of acute articular rheumatism before the manifestations of the disease; while a third, in whom the symptoms seemed to follow an attack of grippe, has already been mentioned. Two of the men had had yellow fever, eighteen years and forty years, respectively, previous to the manifestations of paralysis agitans. Only two of the twenty-four patients were hard drinkers or smokers, and in none was there a history of syphilis. As a matter of fact, the most striking feature of the personal history of all these patients was that they had lived temperate, wholesome lives, apparently devoid of undue strife or uncommon burden. In a few cases the patients alleged that the onset of the disease was coincident with some annoying or exciting experience. For instance, one man was quite positive that the disease occurred immediately after leaving the witness box, where he had been subjected to a harassing cross-examination. Another patient dated the beginning of the tremor from the moment when he heard that all his savings had been lost, owing to the failure of a bank. But in both cases close inquiry revealed that muscular rigidity had antedated these experiences by a number of months. A third patient averred that the tremor developed while he was lying in bed convalescing from an operation for inguinal hernia, but investigation showed that the surgeon had diagnosticated paralysis agitans on the man's admission to the hospital.

This brief review of the etiology of paralysis agitans shows that the most important factors are age, sex, nationality, morality, violent emotions, especially depression, overwork, direct and indirect heredity, and infectious diseases. Apart from the peculiarities of statistics herewith presented which have already been mentioned, relative to these factors, the only point worthy of note is that traumatism was not an alleged or exciting cause in a single instance. This is the more remarkable since Krafft-Ebing finds that in 110 cases trauma was the cause in seven.

Symptoms.—The disease usually develops in a most insidious way.

The first complaint may be of profound and unattributable weariness, usually of one upper extremity. This may or may not be associated with trembling of the part, but the latter is sure to follow. With the feeling of weight, fatigue, and unwieldiness of the extremity, a peculiar form of muscular rigidity develops. This rigidity is more apparent to the patient than it is to the physician on passive movement. Although it usually develops first in the right upper extremity, it soon passes insidiously to the others, and eventually is manifest in every part of the body. It is responsible for the peculiar, immobile, expressionless countenance of the patient, for the bowed condition of his body, and for the slight flexion in all the articulations of the long bones. Moreover, the contraction which is at the bottom of the spasticity conditions the patient's gait, with its short, shuffling steps and tendency to run, called festination; inclination to fall forward (propulsion), as well as the tendency to fall backward (retropulsion), especially if the patient starts to move in that direction, and the inclination to fall sidewise (lateropulsion). It is responsible likewise for the high-pitched, unmodulated, monotonous voice, the fixed manner of speech, and the apparent hypertrophy of the skin which can often be made out. The tremor, which is considered an essential feature of the disease, may never develop; but usually it shows itself a few weeks or months after the rigidity and fatigue in one hand, oftenest in the left. Occasionally it precedes the occurrence of rigidity of the muscles. It gradually creeps up to the shoulder, accompanied by a peculiar subjective sensation of unrest, and passes across to manifest itself in the upper extremity of the opposite side. Later it shows itself in the lower extremities, and finally, as a rule (although this is contrary to the usual statement), in the cephalic extremity. It has three characteristics: First, its location, usually in the hands, which are already brought into a pencil-holding position by the muscular rigidity. It oftentimes causes a forward and backward movement of the thumb and the index finger comparable to those of rolling a pill, often called a pill-rolling movement. Second, its rapidity, from five to six a second, therefore standing midway between the slow tremors and the rapid or fine tremors. Third, it continues while the patient and his extremities are supported and at rest. Although it usually lessens in intensity when the patient attempts and performs voluntary movement, it oftentimes does not do so, and may indeed become slightly exaggerated. Occasionally it stops without apparent cause, but reappears without attributable exciting factors. It is increased by all forms of psychical excitation and by physical indulgence. It may involve all the extremities, and usually does so before the patient passes into the terminal stage, wherein the rigidity and immobility again have sway, as they often do in the beginning. In addition to these symptoms, which are looked upon as the leading features, there are many associated phenomena, all of them apparently perversions of the sympathetic nervous

system. There are subjective sensations of heat, accompanied by local flushings, especially of the face and chest, by local and general elevation of temperature; attacks of sialorrhœa, diarrhœa, and outbreak of sweat, which may or may not coincide with the flushings just spoken of; with sluggishness of the pupils on exposure to light; and profound amyosthenia, both paroxysmal and continuous. The sensory sphere is usually entirely spared. The cutaneous and deep-seated reflexes are normal, unless the phenomena of the latter are prevented by the rigidity. The bowels and the bladder preserve their function, save in the manifestation of hurried action of the sphincters, and the digestive organs remain in fairly good working order. The patient is non-emotional, and exhibits a degree of contentment which is strikingly at variance with that which one would expect to find in a normal individual who had been deprived of the capacity to enjoy life or earn his daily bread, and who had probably been apprised of the eventual outcome of the disease. Nevertheless, there is no dementia; at least, not until the disease is nearly at its end: Aside from the subjective sensations of fatigue, oppressive warmth, fulness in the head, and difficulty of prehension and locomotion, the patient's most frequent complaint is of sleeplessness and inability to get refreshing rest.

The course of the disease is uniformly progressive. In this it is strikingly in contrast with a disease which tradition maintained, and which some still teach is frequently mistaken for paralysis agitans—viz., disseminated insular sclerosis, which is almost invariably progressive and retrogressive. The disease lasts from five to thirty years. As a rule, the patients pass into a bedridden and asthenic condition, which makes different parts of their body vulnerable to infections, such as tuberculosis and pneumonia, and they die of these or other intercurrent disease.

In this connection some of the results obtained from study of the symptoms of twenty-six cases will be given. The distribution of the symptoms was preponderantly diplegic. Thirteen of the cases were diplegic, four hemiplegic, and three tetraplegic. In three of the remaining cases the symptoms were more pronounced on the left side than on the right. This, however, does not place them in the hemiplegic category. Only two of the cases were of the monoplegic type. In one case the lower jaw was distinctly affected. Of the twenty-six, one only was devoid of tremor. This was a most typical case of Parkinson's disease in a laborer sixty-one years of age.

No general statement can be made concerning the earliest symptom in every case of paralysis agitans. It has been said that this is variable with each case. Although tremulousness is the symptom for which the patient first seeks relief, careful inquiry will usually show that rigidity, amyosthenia, and diminished agility have antedated the tremor for a longer or shorter time.

Study of the cases relative to the nature and the rhythm of the tremor goes to corroborate the customary teaching. The rate was in all cases from three to six per second. The amplitude of the tremor increased with the progress of the disease. In three cases the tremor was distinctly intentional—that is, it was increased by purposeful movements. In some advanced stages it was noted that voluntary action had decidedly a quieting influence upon the tremor. In nearly every case the tremor was increased by excitement, reproof, and mental agitation. In two cases only was it noted that physical agitation had a soothing influence upon the tremor. In six cases there were a distinct tremor of the cephalic extremity. As to the influence of sleep, in nine cases of which definite information could be obtained, the tremor always stopped during sleep. One man was very positive that toward morning he was awakened by a spontaneous fit of shaking.

The respiration was studied in eleven cases. In four cases it was regular and deep, without particular change. In four cases it was superficial and of increased frequency, twenty-one to twenty-four a minute. In three of these last cases the expiration was irregular and jerky, while the inspiration was regular and harmonious. In one case it was distinctly noted that the jerkiness of the expiration coincided with the tremulous movement of the upper extremities, but in the other two cases this was not so.

In fifteen cases special inquiry was made concerning the existence of propulsion, retropulsion, and lateropulsion. In seven cases all knowledge of its existence was absolutely denied. In five of the remaining eight cases the patients complained of a tendency to fall forward. In four patients there was at the same time some retropulsion and lateropulsion. In two patients of the hemiplegic type lateropulsion was present, the tendency being to fall toward the diseased side.

In sixteen cases inquiry was made concerning the state of the stomach and bowels. Eight patients complained of obstinate constipation, one patient had chronic diarrhœa, another had occasional attacks of diarrhœa, while the remaining seven made no complaint of their gastro-intestinal functions.

Abnormal heat sensations were complained of in five cases out of fifteen, in which it was noted that inquiry had been made in regard to this condition. The hot flashes were usually of the face, but not infrequently also manifest in the side showing the tremor. Particular search was made for sensory disturbances, since Karplus and others have maintained that some disturbance of sensation, hyperæsthesia, hyperalgesia, hypalgesia, paræsthesia, or spontaneous pain is not uncommon. In only two instances were sensory disturbances elicited. In four cases sweating was a very disagreeable symptom. As a rule, it occurred rather late in the disease. In one instance alone it was the initial symptom. Drooling was a very distressing symptom in two cases.

The mental condition of the patients was noted in nineteen cases. Eleven were cheerful, hopeful, of good disposition, and easy to get along with. This, taken in connection with the fact that some of them were inmates of a charity hospital where the invironment does not contribute to euphoria, means a great deal. In none of the patients was there any perceptible degree of dementia.

Treatment.—Unfortunately, no medicament has yet been discovered that has any influence in shaping the course or changing the outcome of this disease. Beginners in the art of therapy should keep this in mind, and thus spare themselves the trouble of attempting a cure by any of the drugs—and their name is legion—that have been recommended during the last half century. Energy of this kind, and zeal for experimentation may be legitimately expended, perhaps, in trials with new drugs and other health-restoring measures. But it should not be forgotten that one is not always justified in raising the hopes of the patients for recovery so high or so often that when the promises are not fulfilled their confidence is completely shattered and only harm results. Despite this depressing estimate of the value of drug medication in the treatment of paralysis agitans, much can be done to alleviate the symptoms, to prolong the patient's life, and to make him more comfortable. As in all other nervous diseases, dietetic and disciplinary modes of treatment are of the greatest importance. Their value is very conspicuously seen in patients who early in the course of the disease are obliged to seek the shelter of a hospital. Although they are apparently and really not very ill, as wage earners they are incapacitated. The regular mode of life, and all that is implied by hospitalization is conducive to avoidance of wear and tear, and such patients continue year after year without any material change except slight increase of rigidity, tremor, and the other cardinal symptoms. The first indication, then, is for the arrangement of an uneventful life, free from care, strife, excitement, and sordidity, in a congenial environment and healthful climate. As a rule, a cool climate is far more grateful to these patients than a hot one. Life in the country or in the suburbs, where a maximum of fresh air, sunlight, and sleep are to be had, with a minimum of demand on the mind and the body, meets the requirements, providing the vital force of the patient is not put to a severe test in withstanding extremes of temperature.

The diet should be of a simple, nourishing, strengthening kind, and close attention must be given to the functions of digestion and of absorption, so that the bodily weight may be kept at the level which was normal in health. The comfort of the patient can be materially added to by regulation of the bowels and other eliminative avenues. It is absolutely necessary that the patient has the personal care of an attendant or one of the family. Disastrous accidents have not infrequently followed neglect of this precaution. The customary measures for the maintenance of general muscular tone and nutrition, so serviceable in many functional and

organic nervous diseases, such as the application of water and electricity, the use of massage and gymnastics, are not so appropriate in this disease as they are in many others. Nevertheless, the use of lukewarm baths, of from twenty minutes to half an hour's duration, are oftentimes very soothing to the patient, and have a tendency to make the muscular rigidity less dominant. Moreover, they contribute to a moderate feeling of well-being, and aid in securing refreshing rest for which the patient generally clamors. In patients under forty years of age, the application of water from 90° to 75° F. from the hand of an attendant, followed and accompanied by friction, is sometimes serviceable in combating the distressing attacks of local and general heat of which the patient complains. This measure can be utilized daily with patients who react well after it. Reaction may be facilitated by having the patient wrapped in a hot blanket previous to the ablution, by having him stand in hot water during the bath, and by light massage and external heat following it. Massage, applied as stroking and light kneading, fulfils practically the same purpose, and is utilized for the same ends. It tends to lessen the spasticity, to improve the general nutrition, and to increase the patient's capacity for rest. Swedish gymnastics have been warmly recommended by some writers, but I have never seen anything but detriment attend their use. The same may be said of suspension, which has been plentifully tried, and of nerve stretching. They are mentioned only to be advised against. A few years ago Charcot noted that many of his patients with paralysis agitans were more comfortable during and after a short ride in a jolting vehicle. Assuming that the jarring and vibrations had a soothing effect on the nerve centres from which arise the tremor and rigidity, he had a chair so constructed that the patient or an attendant could, by pushing a pair of upright handles backward and forward, communicate vibration to the entire body. Such a chair was in use for many months in my clinic, but nowadays it subserves only a single purpose, that of a seat. Its uselessness is no greater than that of other vibratory apparatuses, such as the one for the head, that have been constructed with a similar end in view. Electricity has practically no place in the therapeutics of paralysis agitans, excepting so far as it is a potent agency for suggestion. One of the most striking results of treatment in paralysis agitans is the temporary amelioration of all the symptoms on undertaking any new form of treatment. I have now under observation a man in the advanced stage of the disease who some years ago maintained that he was materially improved by some mechanical treatment given to him by another physician. On inquiry, it was found that the "treatment" consisted of taking a few tracings of the tremor. Oppenheim states that he has seen considerable benefit follow the electric bath, and especially the application of the dipolar faradic current, but it is not improbable that the bath alone would have been accompanied by quite as much improvement.

The drugs that are in use for paralysis agitans, and from which some benefit in dissipating symptoms and fulfilling pointed indications may be expected, are hyoscyamus and duboisine, Indian hemp, opium, hæmatogenous agencies, such as arsenic and iron, and occasionally gelsemium and veratrum viride. Of these, the most important by far are the two first mentioned. Given hypodermically, which is the preferable way when possible, or by the mouth, they promptly mitigate the severity of the tremor, and have a pronounced tendency to relax the muscular rigidity. They are both powerful toxic agencies, and must therefore be given with care. Hyoscyamus (hyoscine hydrobromide, one-one-hundred and twentieth to one-eightieth of a grain) is said to have more advocates than duboisine, but, personally, I much prefer the latter. It is not so apt to cause disagreeable symptoms, while the effects are coequal. The sulphate of duboisine should be given in from one-one-hundredth to one-sixtieth of a grain, two or three times daily. On the accession of vertigo, cephalic paræsthesia, disturbance of vision, nausea, dryness of the mouth and tongue, it should be stopped at once. In many instances the administration of either of these drugs is followed by almost complete cessation of the tremor for a shorter or longer time, but usually for several days. Unfortunately, they apparently have slight effect in mitigating sleeplessness, amyosthenia, and the feeling of unrest that so many patients complain of. When these become too burdensome for the patient to bear unaided, opium or its alkaloids, preferably morphine, must be given, and especially to cause rest and sleep in advanced cases. Earlier in the disease reliance can be placed on the less baneful sleep producers, such as sulfonal, trional, and paraldehyde, given in the same way as they are for idiopathic insomnia. Alcohol or whiskey in hot water, when taken at bed-time, is often beneficial in overcoming the insomnia. The salts of salicylic acid, particularly those of sodium and potassium, have been widely recommended, especially during the last ten years. They were probably suggested by the patient's complaint of rheumatic pain and by the occurrence of other more characteristic phenomena of rheumatism. After thorough trial, I am convinced that such medication is quite useless. Considering the profound degree of depression of neuromuscular tone which patients with this disease have, it seems incredible that the bromides have ever been recommended or given, but, unfortunately, they have been. They are powerful agencies for harm, and the thought of giving them should never be harbored. In some instances, especially in those cases that are not benefited temporarily by duboisine or hyoscyamus, the tremor and rigidity may be mitigated to some extent by the administration of gelsemium or veratrum viride in from three- to five-drop doses, three times a day. These drugs have served me more satisfactorily as symptom medicines than Indian hemp, which has the recommendation of Gowers, and which has been widely used.

CHAPTER XXXIV.

THE TREATMENT OF EXOPHTHALMIC GOITRE.

(Graves' Disease. Basedow's Disease.)

EXOPHTHALMIC goitre is a neurosis of the sympathetic nervous system attended by vascular and interstitial changes in the thyroid gland which give rise to increased thyroid secretion, characterized by tachycardia, goitre, prominence of the eyeballs, tremor of the extremities, amyosthenia, and emotionalism. It occurs most frequently in females during the period of their fecundity, and especially from the fifteenth to the thirtieth years.

From a personal study of fifty cases, the following conclusions concerning its occurrence have been reached. The proportion of females to males was about 7 to 1, or 88 per cent of the former to 12 per cent of the latter. Of the women 50 per cent were married. The following table indicates the occurrence of the disease according to decades.

1 to 10 years,	0 per cent.
10 to 20 "	20 "
20 to 30 "	36 "
30 to 40 "	24 "
40 to 60 "	20 "

Twenty-six of the number were between the ages of fifteen and thirty. The oldest was fifty-six and the youngest fourteen. As in all neuropathic conditions an examination of the patient's heredity and family history shows the existence of many nervous affections. Very rarely is a history of direct heredity obtained. Not one of the fifty cases gave such a history. In thirty per cent of the cases there was a history of some nervous disease in the family, and in one, of consanguinity.

The factors that so often precede the occurrence of the symptoms of the disease that they may be considered causative of exophthalmic goitre are mental and physical shock and exhaustion and everything that contributes to them. Many examples occur without apparent provocation. Of the attributed causes as given by the patients, thirty per cent were due to psychical shock, fright, worry, and excitement; eighteen per cent to physical injury or exhaustion, and eighteen to infectious diseases. The real etiology of the disease is still very obscure. Study of its occurrence, its symptoms, and its course leads one to the belief that it is primarily a disorder of the sympathetic nervous system, either of its peripheral distribution or its central representation. This is in turn followed by

such excessive and constant functioning of the thyroid gland that it leads not alone to hyperthyroidation, which in itself is pernicious to the economy, but to degenerative changes in the thyroid gland.

Although the disease is attended by the development of pathognomonic symptoms, these symptoms are of very variable severity and combinations. The most characteristic of them are tachycardia, tremor, enlargement of the thyroid gland, and exophthalmos. But the disease may be present without the existence of the two latter. Tachycardia is the most constant and invariable symptom. The pulse is usually small in volume, regular in rhythm, though arrhythmia often occurs when the disease is well marked, and from one hundred to one hundred and seventy-five in frequency. It is liable to paroxysmal variation with or without apparent cause or excitation. It is associated with cardiac palpitation, with pulsation in the arteries of the neck and head, and with more or less hypertrophy. The enlargement of the thyroid gland may be unilateral or bilateral. Oftentimes it is of such slight extent that it is to be detected only on careful examination during the act of deglutition. This is especially the case when there is considerable deposition of fat in the neck. To the touch the swelling is not very firm, and usually a peculiar thrill or vibration is given to the examining fingers. The tumor may become so large as to encroach seriously upon the respiratory tract. The exophthalmos is usually bilateral, although it may be of one side, or it may be more prominent on one side than on the other. The palpebral fissure is widened, and there are no blinking movements (Stelwag's symptom) of the upper lid. When the patient moves the eyes downward, there is a perceptible disassociation between the movement of the eyeball and the eyelid, which is known as v. Graefe's symptom; and when the patient focusses the eyes on an object held close to him, the eyeballs do not converge equally and remain fixed, a phenomenon due to insufficiency of the internal recti originally described by Möbius. Œdema of the eyelids, inflammation of the cornea and conjunctiva, and a degree of ophthalmoplegia, are of rare occurrence. The tremor of the extremities is of a profound neurasthenic type, from ten to fifteen vibrations per second, and subject to considerable variation in intensity. The patient is more or less profoundly myasthenic. This is manifest in many ways, such as in diminution of the respiratory capacity, giving way of the knees, exhaustion from slight effort, and insufficiency of some of the ocular muscles. Vascular and trophic symptoms are often very conspicuous. Of these may be mentioned flushings of the face, and rarely of other parts of the body; subjective sensations of heat and burning, hyperidrosis, which may be unilateral or segmental; coldness of the extremities; unattributable attacks of diarrhœa, associated with ballooning of the abdomen; polyuria; dermographic skin, and cutaneous pigmentation. The patient frequently complains of insomnia, of a feeling of profound unrest, of great irritabil-

ity, of a gnawing feeling in the epigastrium like that of genuine hunger, and of almost any one or more of the symptoms of the neurasthenic state. Clinically, many forms of the disease might be described. The atypical varieties are in reality as common as the typical. The abortive and the severe types of exophthalmic goitre are also not very rare. It may truthfully be said that a neurasthenic state, plus persistent tachycardia, is sufficient in nine cases out of ten to justify the diagnosis of this neurosis. The course of the disease is by no means constant. It is liable to spontaneous recovery, to prolonged remissions, and to exacerbations. Rarely the disease occurs abruptly with profound and prostrating symptoms which lead to a fatal outcome within a few weeks. Such cases are attended with extreme emaciation, great depression of the vital forces, and delirium. The clinical picture and the physical signs constituting exophthalmic goitre vary with the type and with the course of the disease.

Treatment.—The successful treatment of exophthalmic goitre depends largely upon the physician's ability to secure the patient's full co-operation in carrying out the details of the plan looking toward mental and physical quietude, and restoration of the nutritional balance. In my own experience there are few nervous diseases so unsatisfactory to treat in dispensary practice and few that are so amenable to treatment in hospital and in private practice. The reason for this is that dispensary patients are not only beyond the control of the physician, but are socially so situated that they cannot properly use the measures: rest, graduated exercises, hydriatics, electricity, hygienic and dietetic rules, which immeasurably outweigh drug therapy. Many varieties of treatment and plans of treatment have been recommended. Some of them are based on (1) empiricism, others (2) are claimed to be founded upon capacity to thwart the cause of the disease, theoretically established, while others still (3) purport to meet special indications, and by inhibiting the phenomena of the disease to cure the disease itself. Under the first may be mentioned the administration of phosphate of sodium, which given in doses of from one to four drachms in twenty-four hours unquestionably often ameliorates the symptoms, with subjective and objective improvement. Here also may be mentioned operations on the nose and the nasopharynx. Judging from the literature of so-called cures, operation for removal of intranasal growths and obstructions is sometimes of real service. Under the second caption may be included such treatment as the use of intestinal antiseptics, the rationale of which is based upon the belief that toxic products absorbed from the alimentary tract have a pernicious effect upon the vasomotor area in the oblongata, and are thus responsible for the genesis of the disease. No one will deny that a disease whose symptoms are almost exclusively manifest through the vegetative nervous system is always associated with disturbance of digestion and absorption, not to speak of metab-

olism. Therefore one may appreciate the benefit to be had from strict regulation of the diet, and the unremitting use of so-called intestinal antiseptics, without leaning toward the theory that the disease is an auto-infection of intestinal origin. Under the third heading may be mentioned the use of drugs that reduce the frequency of the heart beats or the size of the goitre. These include digitalis, strophanthus, belladonna, aconite, nitroglycerin, the iodides, and bromides. The two first-mentioned drugs have been very widely recommended, and they could hardly have secured their reputation in the treatment of this disease without deserving it. Nevertheless, I am unable to say one word in their behalf. After thorough trial of them it only remains to say that the effects which it is said they produce can be so much more easily and safely obtained by non-medicinal measures that I never employ them. It is said that the administration of digitalis slows the beating of the heart. It does in a normal person, but not in one who has Graves' disease. More decided slowing of the heart can be obtained by the application of a cold-water compress to the precordium, by the use of cold douches under properly regulated pressure to the spine and the extremities, and by rest than by the use of strophanthus. Belladonna is supposed to act beneficially by virtue of its peculiar property of stimulating the unstriped muscular fibres, thus giving tone to the vascular system, and overcoming arrhythmia. It has been used externally as an ointment to the goitre and as a plaster over the heart. The results of its use in my experience are not such as to warrant recommending it, save to meet some special indication, such as hyperidrosis and polyuria. Of this class of medicines, the one that has seemed to me of real service is aconite, given in the form of McKesson & Robbins' pill aconitia as originally recommended by the late E. C. Seguin. Given in gr. $\frac{1}{200}$ dose, four times daily, and increased until the patient is taking twice this quantity, or even more according to the effects that it produces upon the neurovascular system, it seems to me the most important medicinal adjuvant in the treatment of this neurosis. It acts symptomatically, according to its well-known physiological effects, to lessen the number of heart beats and to lower vascular tension. It is recommended merely as an adjuvant and in nowise to be compared with the physical, hygienic, and dietetic measures which are about to be detailed. Iodide of potassium, when given internally or when thoroughly rubbed into the goitre, helps to reduce the enlargement of the thyroid, but when given in sufficient doses to do this it tends to increased cardiac pulsation, to disorder of digestion, and to impaired assimilation. Its administration, therefore, defeats its own ends. Few writers recommend the systematic use of bromides. Mobius, however, believes that the mental and physical excitability are best combated by giving from thirty to sixty grains of any of the commoner bromide salts in water on retiring. Although it is refreshing to note any therapeutic recommendation from

this writer which is not supposed to act "psychically," it is to be hoped that his advocacy of the bromides in the treatment of exophthalmic goitre will not lead any one to their systematic use. In the treatment of almost any patient there are occasions when one or a few doses of bromide salt are indicated to combat special symptoms, such as profound restlessness, unremitting agitation, subjective feelings of heat, and functional palpitation, but such a drug should not be given continuously. Nearly every symptom medicine in the pharmacopœia has been recommended at one time or another in the treatment of Graves' disease, but very little benefit is to be expected from strychnine, picrate of ammonium, picrotoxin, ergot, arsenic, cactus grandiflorus, etc. On the other hand, restoratives whose effect is to promote constructive metabolism may be given occasionally with good results. As a rule, patients with this disease do not tolerate iron, although it has been and is still given very extensively. The simple bitters, mineral acids, and aids to digestion may be given temporarily to meet specific indications. Dilute sulphuric acid, ten drops three times daily, has recently been recommended by Vetlesen of Christiania.

The first most important matter to decide in beginning the treatment of a patient with exophthalmic goitre is how much physical exercise can be taken without increasing the rapidity of the heart or in any way contributing to the patient's irritability, restlessness, and myasthenia. If the disease is of considerable severity or well developed, usually no physical exercise can be taken without aggravating some of the symptoms. Therefore it is necessary in the majority of cases to confine the patient for a time to bed. As soon as the neurovascular system has been steadied by enforced rest, and the contributory measures that should be employed, the patient should be allowed and encouraged to take such exercise as will aid constructive metabolism without increasing the heart beat or in any way adding to her discomfort. Such exercise will exclude everything bordering on the violent, such as running, climbing, riding, and bicycling, but it may include graduated gymnasium exercise, walking, golfing, and croquet. The advisability of allowing the patient to exercise will depend entirely upon the effects produced. The patient should be in an environment that contributes to mental ease and relaxation, devoid of liability to emotional excitation or depression, and not dependent upon her own resources for amusement and relaxation. If it is found unnecessary to confine her to bed during the entire twenty-four hours, it is well to insist that the time of arising be delayed until near midday, and that the retiring hour be early in the evening. The dietary should be one that is at the same time highly nutritious and easily digested. Food should be taken frequently in small quantities, and nitrogenous substances in the shape of meat should be taken but once a day. For the majority of cases, an exclusive milk diet is not advisable. Yet occasionally when gastric and intestinal fermentation are conspicuous, it is advisable to restrict

the diet to milk and milk preparations. Green vegetables, especially those of coarse texture and easily digested, should be taken freely. The patient should be urged to drink freely of water. Alcoholics, tea, coffee, and tobacco should be absolutely interdicted. The safest guide in directing the dietary is the bodily weight. Progressive loss of flesh and the occurrence of cachexia demand the use of tissue reconstructives.

Hydrotherapy has the same important part in the treatment of exophthalmic goitre that it has in the treatment of neurasthenia. It is impossible to state specifically the hydriatic procedure indicated in every case. In other words, there is no such thing as a fixed hydriatic prescription. Every case is a law unto itself. As a rule, it may be said that tachycardia is best combated by the application of a cold compress over the heart, and by the use of douches of from 80° to 70° F., and from ten to fifteen pounds pressurel over the spinal column. General vasomotor tonicity is obtained from cold ablutions over the entire body, the water being applied from the hands of an attendant, especially after the surface temperature has been slightly increased by wrapping the patient in a warm sheet and blanket. Lukewarm half-baths answer the same purpose. Restlessness, irritability, and myasthenia are combated by the use of the wet pack. In my own experience the latter symptom is more amenable to the cold-water douche, applied for a few seconds to the legs and feet, and the hands and arms, than by any other measure. I have often seen diarrhœa cease after the application of the Neptune girdle.

Balneotherapy is not of great importance, save as it serves to fulfil the indications that have already been spoken of concerning the patient's environment. Patients with this neurosis seem to be as comfortable at the seaside as in the mountains, but sea bathing should never be indulged in. Physicians living at mineral springs and watering-places have advocated prolonged sojourns at such places, but there is very little disinterested testimony in support of such a plan.

Electricity has long been of good repute in the treatment of this disease, and there are few diseases in which its reputation is better founded. Mention will be made only of the galvanic current, as it would seem to be the consensus of opinion that faradic electricity, despite Vigouroux's advocacy of it, is of very insignificant service. The approved method of using the galvanic current is the stabile application over the cervical sympathetic, and to the enlarged thyroid gland. The large indifferent electrode (anode) is placed over the lower cervical vertebræ, and the small cathode electrode, from two to three centimetres in diameter, at the inner border of the middle of the sterno-cleido-mastoid muscle, while a current of from three to four milliamperes is allowed to flow for from three to five minutes. The same precedure is repeated on the other side. Then a similar current is allowed to pass through each lobe of the thyroid gland for a corresponding time. This procedure should be repeated once or

twice daily. Some authors have recommended very much stronger currents, but personally I have never seen benefit follow their use. Static electricity may be used for its general tonic and mental effect, but care should be taken that it does not excite the patient or make her more restless. The electrical treatment should be kept up week after week for several months and always in connection with the other physical measures previously spoken of.

Surgical Treatment of Exophthalmic Goitre.—During the past few years the surgical treatment of exophthalmic goitre, consisting of ligature of the thyroid arteries, partial or complete resection of the thyroid gland, bilateral division of the cervical sympathetic or the ganglia, and simple exposure of the thyroid gland, with consequent retrogression and atrophy of its tissues, so-called exothyropexy, has come prominently into vogue. At the present writing, records of two hundred and fourteen cases are to hand. The operation that would seem to be most favorably considered is that of partial thyroidectomy. Judging from the statistics of individual writers, such as Booth, Putnam, Saenger, Kocher, Kümmell, and others, it would seem legitimate to state that the results of operation have been sufficiently favorable to warrant its recommendation. But when the entire field of operated cases is surveyed, the fact that the mortality from these operations is greater than the mortality from the disease itself (viz., from ten per cent to fifteen per cent) admits of no denial. Until this mortality rate is reduced, and until cases reported as cured from operation are so completely relieved of symptoms that other physicians aside from those interested in the operation are convinced of the cure, surgical procedure cannot be recommended in the treatment of exophthalmic goitre until after the general plan of treatment outlined above has been thoroughly carried out, and has failed to hold in abeyance the manifestations of the disease. In recent times operations on the cervical sympathetic nerves and their ganglia have found considerable favor in France. Those who urge them accept Abadie's views of the pathogenesis of Graves' disease, namely, that it is due to persistent irritation of the vasodilator fibres of the sympathetic and of their nuclei of origin, the goitre forming as a result of vascular engorgement of the thyroid. Although the results of operation as given by its advocates Jaboulay and Jonnesco, and their followers seem gratifying, the real value of the operation has not yet been proved. It may safely be said that it should be tried in those cases that do not yield to the other less dangerous plans of treatment. The mortality of operations on the cervical sympathetic would seem to be less than that of thyroidectomy.

Serum therapy has been tried with some apparently beneficial results in this disease. It is generally accepted that at least some of the manifestations of exophthalmic goitre are due to hyperthyroidation. It was therefore very astonishing that reports of cures from thyroid feeding

were recorded, but when it was found that the substance administered was not thyroid but thymus, it was thought that this gland of unknown function might have some property to check the manifestations of the disease. With that end in view, fresh glands of the sheep have been administered by a number of experimenters, but the results have not been satisfactory, nor has the administration of the serum from dogs whose thyroids were previously extirpated.

Summary.—In brief, then, the treatment of exophthalmic goitre consists in the proper utilization of rest, dietary, environment, water, electricity, exercise, hygienic and disciplinary measures. In many cases, certain symptoms will call for particular interference, but the indications in such conditions are in nowise different than when the same occur apart from exophthalmic goitre. Œdema of the eyelids, inflammation of the conjunctiva and cornea due to exposure through the retracted lids, hyperidrosis, insomnia, diarrhœa, etc., call for the treatment which is adapted to them when occurring under different circumstances.

CHAPTER XXXV.

THE TREATMENT OF MYXŒDEMA.

Myxœdema is the name applied to a progressive cachexia or mucoid transformation of the connective tissue all over the body, but especially of the subcutaneous tissue, associated with mental and physical sluggishness, dependent usually upon fibrosis of the thyroid gland with atrophy of the secreting epithelium. Occasionally it is due to syphilis and to actinomycosis of the gland. The disease is identical with that which results in animals after extirpation of the thyroid gland. It occurs predominantly in women during the later years of fecundity, between thirty-five and forty-five. When the disease occurs in infancy, it is known as cretinism, which may be congenital, primary, sporadic, or endemic. The predisposing and exciting causes of the disease are unknown. The ancestry of such patients often shows considerable neuropathy, but rarely similar disease. Occasionally the disease has followed in the wake of Graves' disease.

The disease is of variable intensity depending upon the degree of thyroidal fibrosis. In all cases it is usually of slow onset and gradual development. The skin becomes thick and dry, and is the seat of resistant œdema. This œdema is most conspicuous in the face and hands of which it causes conspicuous and profound deformity. The eyes are half-closed and expressionless, the cheeks and lips are enlarged, thickened, and somewhat pendulous. The face has a full-moon appearance lighted up by a bluish-pink area or conglomerate points over each malar process. The nose is thickened and has a stunted appearance. The hair of the head and face has a lifeless appearance, and soon falls uniformly or in patches. The gums are turgescent, of bluish color, and bleed easily. The fingers and hands become swollen and devoid of nimbleness and dexterity. The nails become bruised and brittle and crumbling. Such patients are slow and deliberate in all their movements; mentation is very sluggish, and the sufferers betray very little interest in themselves or their environment. The pulse is weak and slow, the temperature somewhat subnormal, and the patient complains of feeling cold. The secretions and excretions of the body, particularly the perspiration and urine, are very much diminished. The latter often contains albumin and hyaline casts. Occasionally the psychical disturbance assumes the form of delirium, but usually it is manifest as dementia. Chapman of London has recently called attention to what he believes to be an early

diagnostic sign in myxœdema. This consists of a "certain sloppiness of the conjunctivæ best observed by pushing up the lower eyelid at the outer angle of the eye, caused by the presence of mucin." When this condition is found, the urine being of normal specific gravity and devoid of albumin, and the patient is anæmic, myxœdema should be suspected. The course of the disease is slow and liable to frequent remissions. Untreated it leads to the development of such profound depression of vitality and deterioration of nutrition that the patient succumbs to general asthenia and exhaustion, or to some acute intercurrent disease which under other circumstances would be considered trivial.

Treatment.—The treatment of myxœdema was for a long time most unsuccessful, although a few cases were recorded in which improvement occurred under general tonic and eliminative treatment. Cases of myxœdema that are due to syphilis and actinomycosis recover when these diseases are successfully treated. Not until it was shown experimentally that myxœdema followed extirpation of the thyroid gland, and that such myxœdematous condition disappeared after thyroid implantation, did the real treatment of this disease, which forms such an important chapter in the history of experimental therapeutics, begin. It was soon after shown by numerous investigators that the essential substance of the thyroid gland which acts curatively could be introduced into the body by grafting, by subcutaneous injection of an extract of the thyroid, through feeding of the raw thyroid, through the inunction of a thyroid lanolin cream, and by the administration of the dried or powdered gland in the shape of capsules, tablets, or pills. The latter has come to be the way in which the thyroid extract is now almost universally administered, but the raw gland may be given—from one-eighth to one-half of a sheep's thyroid daily. The tablets are manufactured by many wholesale chemists, both here and abroad, and the preparations of one seem to be as useful as those of another. The average dose to begin with is from two to five grains of the desiccated powder, the dose being gradually increased until some such manifestations as occipital headache, urticaria, nausea, vomiting, diarrhœa, etc., show that hyperthyroidization has begun. The treatment should then be interrupted for several days, during which time the patient should be kept in bed under supportive treatment. When such symptoms disappear, the administration of the thyroid extract should be resumed. After from four to eight weeks of treatment the beneficial effects will begin to manifest themselves by disappearance of the subjective and objective myxœdematous symptoms. It is especially in advanced cases that the beginning treatment must be carried out with great caution, for the organic enfeeblement of the heart which almost always exists does not tolerate much stress being put upon it. The patient should be kept in bed for the first few days or weeks, and if symptoms of heart failure occur they should be combated with stimulants and digitalis. The general care

and treatment of the patient should be most rigorously carried out by the use of a nutritious diet, consisting largely of milk, green vegetables, and easily digested fats. The nitrogenous substances in the shape of lean meats should be decreased. The patient should be instructed to husband the energies while the vital forces are stimulated by the administration of iron and strychnine in small quantities. Unfortunately, the thyroid treatment of myxœdema is not such an unmitigated success as the published reports in the beginning would seem to indicate. When the administration of the extract is stopped, symptoms of the disease are sure to recur sooner or later. Disappearance of the symptoms of myxœdema indicates that the first stage in the treatment of the disease has been reached. It usually suffices to give it now in much smaller doses than at first, but the dose must be determined in each individual. The second and important part of the treatment which should be impressed upon the patient is the daily administration of a dose of thyroid equal to the daily output of a normal gland. It should be a part of the diet just the same as bread is.

Recently, the iodine-bearing substance of the thyroid gland known as iodothyrin has been recommended in place of the thyroid extract. It is claimed that a grain of the powder is about equal to one grain of the gland. It is administered in from five- to fifteen-grain doses, sometimes even in twice this quantity, and the results so far obtained warrant its unequivocal recommendation. So far, at least, it would seem that disagreeable and untoward results are less liable to follow its administration than that of thyroid extract. It is an important addition to the therapeutics of this disease, as it offers a substance that can be given alternately with thyroid extract, and with prospects of success.

The treatment of cretinism is not materially different from that of myxœdema. The earlier the condition is discovered and treated the greater are the prospects of cure. It should not be forgotten that good results are often had in the treatment of cretinism of long standing—eight to ten years. In such cases the body is more improved than the mind. It is only in cases in which the treatment is started early that normal mental development can be expected. In starting the treatment gradually increasing doses of the extract should be given until the symptoms disappear. It is of the greatest importance that tonifying measures be administered simultaneously. As in adults the treatment must be continued as long as the patient lives. The permanent dose must be determined in each case.

CHAPTER XXXVI.

THE TREATMENT OF SYMMETRICAL GANGRENE—NEUROPATHIC GANGRENOUS TROPHONEUROSIS (RAYNAUD'S DISEASE).

THE symptom complex to which the name Raynaud's disease is given consists in the occurrence of vasomotor phenomena in the extremities, usually symmetrical, varying from subjective coldness and objective pallor and lividity, through local asphyxia, and ulceration, up to complete gangrene. The disease occurs nearly twice as frequently in males as in females. The majority of cases occur between the ages of twenty and forty. It is of rare occurrence in early childhood, and it is never encountered during late senility. It is sometimes met in patients who have other nervous diseases, such as hysteria, epilepsy, tabes, myelitis, syringomyelia, neurasthenia, and acute mania. Its existence is sometimes associated with urticaria, scleroderma, erythromelalgia, and other dermatoneuroses. A neuropathic diathesis is to be made out in a large proportion of cases. The patients are not infrequently weak and anæmic, the result of inherited conditions, or of some toxic agency, exposure to cold or intercurrent diseases. The exciting causes so far as they have been determined are fright, frost-bite, profound fatigue, and trauma, especially to the sympathetic system, as from blows or injuries over the abdominal plexuses.

Symptoms.—The symptoms of the disease develop paroxysmally, after fright, shock, and injury, or without attributable cause and show themselves as paleness and glossiness of the fingers or toes, rarely the nose and the ears. With this there is a sensation of tingling and twitching and diminution of dexterity and sensibility. After a variable duration, these phenomena may disappear, or the parts may become exsanguinated, waxy, and colorless, forming the so-called dead fingers. The skin may become shrivelled and puckered, and the members themselves quite useless. This stage, after lasting from a few minutes to several hours, may pass away without leaving a trace, or it may pass into the second stage, that of local asphyxia, in which the parts assume a bluish-black appearance as if they had been dipped in ink. The epidermis over the affected parts may show small blisters which often contain a quantity of blackish blood. After from one to several days, the skin over the black portion of the affected extremities separates from the adjacent parts, the derma becomes extensively destroyed, and small ulcers can be seen eroding the subcutaneous tissue, while the terminal phalanges become shrivelled and mummied. If the gangrenous process is limited to the

formation of small necrotic areas, these heal slowly after the attack has passed off, leaving small scars. If the gangrenous process is more severe, the ends of the extremities become dry and shrivelled and a line of demarcation forms in the healthy tissue from which a reactive process is set up, which separates the dead part. The process of separation and cicatrization if left unaided frequently extends over many months. In the majority of cases, however, the gangrene does not go on to this extent, at least not until after the patient has experienced many attacks. Very rarely are the cheeks, lips, tongue, penis, vulva, and nates the seat of trophic changes.

The constitutional symptoms are very variable. In the beginning there is oftentimes a feeling of chilliness, nausea, anorexia, and great prostration. The disease is an afebrile one, the surface temperature being often subnormal. Intermittent hæmoglobinuria is rather a common symptom. Mental symptoms, such as profound depression, transient attacks of aphasia, convulsions, and unconsciousness, occasionally occur. They may be attributed to regional ischæmia of the brain, resulting from spasm of the arteries. The first and second stages usually last from a few hours to several days. The duration of the third stage depends upon the severity of the process, and its responsiveness to treatment. The disease is very liable to relapse, and succeeding attacks are apt to be severe. In children, the disease runs a very rapid course and frequently there is nothing paroxysmal about the attack. The child may die within a few days after the symptoms first show themselves. On account of the great depravity of nutrition from which most of these patients suffer, they are liable to the development of intercurrent infectious diseases, to which they succumb.

Treatment.—The most important factors in the treatment of an attack are to relieve the pain and to favor restoration of the circulation in the affected extremity. If the pain is very severe, morphine should be given internally. It should never be injected into the seat of the pain, for irritation of these parts increases the liability to gangrene, and its intensity if it is already present. The affected parts should be wrapped in cotton wool, and placed in a position that favors the vascular circulation of the parts. At the same time dry heat should be applied over the abdomen and over the affected extremity. It is thought that nitroglycerin or nitrite of amyl administered internally has a beneficial effect to relax the contraction of the blood-vessels and to favor restoration of the circulation. When the patient is seen early, these medicines should be given, and at the same time an attempt should be made to stimulate the cardio-vascular apparatus by the administration of strychnine. Electricity has been used extensively, but its therapeutic value is very small. It is recommended that the positive pole be applied over the side of the neck and the negative pole in a basin of warm salt water, in which the extremities

are immersed in turn, while from five to fifteen cells generate an electric current. In the milder manifestations of the disease, light massage is decidedly beneficial. No attempt should be made to use it, however, after the disease has passed the second stage. When gangrene occurs, it should be treated according to the principles of modern surgery.

More important than the symptomatic treatment is the regulation of the patient's life, and the adoption of measures to increase his nutrition and strength. If one is successful in doing this, the patient may tolerate the exciting causes of an attack, such as exposure to cold, mental shock, and the like, without any bad results. The neuropathic diathesis and the other nervous diseases with which Raynaud's disease is associated, should be persistently combated. The patient should be instructed to live a life of simplicity, tending toward bodily and mental quietude; to take regular and systematic exercise, and to avoid fatigue, depression, and other occurrences leading to exhaustion. When it is impossible to do this, the tonifying effects of hydrotherapy, gymnastics, massage, and so forth, should be sought, while the general health should be supported by the administration of restoratives and alteratives, attention to the dietary and the general hygiene.

CHAPTER XXXVII.

THE TREATMENT OF ANGIONEUROTIC ŒDEMA.

Angioneurotic œdema is a disease characterized by the appearance of circumscribed swellings on different parts of the body, particularly the face, throat, and extremities, usually without apparent cause or premonition, transitory in duration, and non-inflammatory in nature. The most important factors in its etiology are an unstable nervous system, manifesting itself as hysteria, neurasthenia, or in direct hereditary transmission of the disease, and overwork, exhaustion, and toxic influences, such as those of tobacco, tea, and infectious diseases. It occurs more commonly in early adult life than later, but many cases have been reported in children and especially those victims of the nutritional disorder known as rachitis. Among the exciting causes are exposure to cold, gastric irritation, trauma, fright, and the ingestion of alcohol. The exciting causes that produce urticaria produce angioneurotic œdema. It is highly probable that the latter differs from the former only in its greater intensity.

The manifestations of the disease, consisting of circumscribed swelling, associated with a local feeling of unwieldiness and tension in the part, usually present themselves without warning on the face, lips, tongue, pharynx, forehead, buttocks, or genital organs; in some instances the patient complains a short time before the appearance of the swelling of a feeling of depression and exhaustion, associated with distress referable to the tongue. The swelling reaches its full development in from one to three or four hours. It does not pit on pressure. In the beginning it has very close resemblance to the swelling produced by a mosquito bite; the color is whitish, with a distinct rose tinge, but in some cases the skin over the swelling is of a dull roseate hue, with a whitish shading over the centre. It lasts from a few hours to several days. It may occur in separate parts of the body simultaneously, but frequently its disappearance from one locality is the signal for its appearance in another. As a rule it does not show itself in more than two or three localities at one visitation. The subjective sensations accompanying the swelling are those of exhaustion, providing the swelling does not encroach upon an organ such as the eye, the stomach, penis, etc., or does not block up the conductivity of a passage, such as the mouth, pharynx, larynx, and intestines. It is highly probable that similar œdema may occur in the substance of the brain or in the pia and cause symptoms in keeping with its localization. When the mucous membrane of any of the pas-

sages, especially of the larynx, is the seat of swelling, the symptoms may be not only distressing but inimical to life. The gastro-intestinal symptoms which occur in from one-third to one-half the cases consisting of a feeling of weight in the epigastrium, nausea, vomiting, diarrhœa, and severe colicky pain, are undoubtedly associated with an œdematous state of the gastro-intestinal mucous membrane. The attacks occur at variable periods, and in the interval the patient may be in customary health.

Treatment.—Unless the œdema appears in the larynx or pharynx, it does not call for any particular treatment at the time of the attack, although the swellings will disappear more rapidly if the patient is kept at rest in an equable temperature and if dry heat is applied to the œdematous area. Compression by means of a flannel or an elastic bandage applied lightly sometimes seems to facilitate the disappearance of the swelling. Œdema of the epiglottis and larynx should be treated by local applications of warmth and scarification, while the physician holds himself in readiness to perform tracheotomy. The indications for general treatment are to discover, remove, and mitigate the causes and to tonify the patient's neurovascular system. Little progress will be made in preventing recurrence of the manifestations until the cause has been discovered. Tonics, such as strychnine and iron, invigorating baths, particularly those beneficial in hysteria and neurasthenia, and exercise and massage, are the most important measures in the treatment of this disease. The dietary and the digestive capacity of the patient should be carefully inquired into, and derangements of them corrected. Special indications, such as the occurrence of excess of uric acid, intestinal putrefaction, and gouty manifestations, require specific medication.

Intermittent Swelling of the Knee.

Under the name intermittent swelling of the knee, or hydrops genu intermittens, a condition of accumulation of fluid within the knee-joint (very rarely are other joints affected), occurring without apparent cause in otherwise healthy individuals, has been described. The swelling of the joint occurs periodically, usually with fortnight intervals, and lasts from one to several days. It is not attended with any manifestations of inflammation, nor does it give discomfort to the patient except from the mechanical effects. It is usually considered a vasomotor neurosis very similar to angioneurotic œdema. The etiological factors that have been spoken of are not unlike those that are believed to be causative of the latter affection. Occasionally it alternates with some of the ancillary phenomena of Basedow's disease, such as suffusion of the face, polyuria, hyperidrosis, and urticaria.

The affection is supremely unamenable to treatment. Antirheumatics appear to be useless. It may recover spontaneously, or after the use of massage, electricity, quinine, arsenic, and general tonic therapy.

CHAPTER XXXVIII.

THE TREATMENT OF ACROMEGALY.

Acromegaly is a chronic disease characterized by great increase of the extremities of the body, the hands, the feet, the face and the head, due to an increase in the volume of all the tissues, hard and soft. The disease occurs in every race and affects males and females about equally. It occurs during early adult life, but is most frequently discovered between the ages of twenty and forty. Congenital cases have been recorded. Schwoner has recently described the occurrence of the disease in mother and daughter. The causation of the disease is unknown. It occurs occasionally in patients who have syringomyelia, tabes, hypertrophic osteo-arthropathy, gigantism, and the degenerative psychoses. Among the exciting causes of the disease may be mentioned worry and depression, fright, exposure to cold, injuries, alcoholism, rheumatism, and gout. It is generally believed that acromegaly is in some way dependent upon lesion of the pituitary gland, as the tissues of this organ have been found diseased or the seat of new-growth in almost every case that has come to autopsy.

Symptoms.—The symptoms of the disease are of insidious onset, and frequently are recognized first by the physician who sees the patient accidentally, or for some trivial complaint. The patient may have remarked that the extremities have gradually been getting larger, and that he is not so alert mentally and physically as he was formerly. Headache of great severity and unamenability to medication is an early symptom in many cases. These, associated with general neurasthenic symptoms, constitute the complaint in the beginning. When the patient is examined, it is found that he has a peculiar posture, both in standing and walking, the neck is bent forward, while the head is tilted slightly backward, in order to bring the eyes up to a level; the shoulders are rounded and stooping, the chest is bulging, and the gait is unelastic and heavy. The patient's posture is accentuated by the prognathous, heavy, projecting lower jaw. The lips are large, the mouth is expressionless, the naso-labial creases are deepened to fissures. The nose is enlarged, proboscis-like, frequently slightly pigmented, and with wide nasal aperture; the eyes are deeply set, and overhung by thickened supraorbital arches studded with coarse and thickened eyebrows. The lower part of the forehead is bulging, and this gives a retreating appearance to the upper part. The malar bones and

zygoma stand out prominently; the cheeks are flattened; the ears are enlarged; the hair is coarse and dry, and the skin frequently pigmented. The entire facial expression is dull and unanimated, a patient, grieving sort of look. The hands and feet are enlarged, but there is no deformity, that is, the enlargement is symmetrical and all the tissues participate in the hypertrophy. The spinal column shows a cervico-dorsal kyphosis, which, with the enlargement of the thorax, gives the patient a hump in front and behind. The external genital organs are frequently hypertrophied in the female, while the internal genitals of the female and the genital organs of the male are usually atrophied. Impotence of the male and cessation of menstruation in the female is the rule to which there are exceptions. The special senses, save that of sight, are intact. The impairment of sight and the encroachment of the visual fields, usually bitemporal hemianopsia, are proportionate to pressure made on the optic chiasm by the pituitary gland. The visceral organs are as a rule normal. The voice is profoundly altered, low-pitched, resonant, voluminous, and of a peculiarly disagreeable intonation. Speech is slow, guttural, embarrassed, the result seemingly of unwieldiness of the enlarged tongue and other tissues of articulation. The urine is usually increased in quantity, and sometimes contains sugar or albumin. The patient is often irritable, depressed, morbidly sensitive, and introspective, forgetful and antipathic to mental indulgence. The course of the disease is progressive, and invariably ends in death from exhaustion, suicide, or intercurrent disease.

Treatment.—The treatment is entirely symptomatic, as the etiology and pathology of the disease are comparatively unknown. Measures should be adopted to delay the loss of strength and to invigorate the patient. These are massage, hydrotherapy, gymnastics, and, if possible, some easy and absorbing occupation. Although these may have little efficacy in delaying the course of the disease, they inspire hope and confidence while tending to increase the patient's strength. When possible, the mode of life and the dietary should be carefully regulated, especially if on examination of the excreta some drain, such as albuminuria, glycosuria, and incompletely digested food are found. One word of warning may be said in reference to the dietetic treatment of diabetes occurring with acromegaly. Acromegalics do not tolerate deprivation of the calorifacients, as do other diabetics. Bulimia and constipation should both be guarded against. The latter should be counteracted by the addition of coarse vegetables to the dietary and by the administration of high enemata of cotton-seed oil. The headache, neuralgia of the branches of the trifacial nerve, and pains in the extremities are best combated by the use of phenacetin, antikamnia, and other modern analgesics. Headache that has proven rebellious to this treatment has been benefited by trephining. Extract of thyroid gland and of the pituitary gland have been

employed empirically, and many writers have reported beneficial results, especially from the use of the former. Thyroid extract seems to have the power to reduce obesity, and by so doing it may seem to exercise a beneficent action on the disease. This is illusory, however, and its administration may add to the muscular weakness. Based upon the ground that functional destruction of the pituitary body is the cause of acromegaly many clinicians have employed extracts of the pituitary body in the treatment of the disease. It would seem to be the consensus of opinion that such treatment has failed to produce beneficial results. Further experimentation in this direction is, however, necessary. Iodine has been used very extensively, both externally in the shape of the ointment, and internally in the shape of iodide of potassium. Occasionally the iodine salts and arsenic have seemed to be of much benefit in staying the progress of the disease, but it is not improbable that such amelioration has been coincident with one of the remissions natural to the disease. Paræsthesia of the extremities, hyperidrosis, sleeplessness, and mental depression oftentimes call for specific medication, but the treatment under these circumstances is not unlike that appropriate for such symptoms occurring with other diseases.

CHAPTER XXXIX.

THE TREATMENT OF SCLERODERMA.

Scleroderma is a trophoneurosis resulting in induration and atrophy of the skin and subcutaneous tissue. Clinically, two forms are distinguished, the diffuse or symmetrical variety, and the circumscribed known as morphœa, or Addison's keloid. Pathogenetically the disease is apparently a cutaneous infiltration which gives rise in the beginning to swelling, preceded and accompanied by vasomotor disturbances, and later by the absorption of the infiltrated tissue and the occurrence of a scar-like atrophy. The etiology of the disease is unknown. It occurs preponderatingly in young females, and especially in those who have had at some more or less recent preceding time such infectious diseases as erysipelas, scarlatina, pneumonia, malaria, tuberculosis, and typhoid fever. Other factors which seem to have a causal relationship are exposure to cold, injury, grief, anxiety, and worry. The disease is apt to occur in neuropathic individuals, and occasionally is superimposed upon syringomyelia, chronic myelitis, and Raynaud's disease.

Symptoms.—The first manifestations of the disease are usually local, consisting of a feeling of stiffness and unwieldiness in the parts affected. Examination then reveals different conditions depending upon the stage in which the disease is encountered. When the sclerodermatous process has reached its height the skin is of leather-like feel and consistency, and drawn so tightly over the parts that it causes immobilization if it is about a joint, or atrophy of the soft and hard parts over the extremities. Attempts to pinch up the skin or to pit it by pressure are not successful, but when the finger is drawn quickly and firmly across the surface, a whitish line with a pink border remains. If the face is affected, the features are obliterated, the expression being that of a death-mask. When the skin over the chest is involved, the latter is flattened, the breasts compressed, and respiration often impeded. The occurrence of scleroderma in other parts of the body produces deformity consonant with the fixation and muscular atrophy that accompany it. The circumscribed variety of scleroderma presents itself in the form of patches, bands, or streaks, varying in size from the end of the finger to the palm of the hand and even larger. They develop gradually, frequently on parts of the body that are not easily seen, such as the back of the neck, but more often on the chest and over the distribution of the fifth nerve, especially of the supraorbital branch. On the lower extremities the cutaneous surface to

which the terminal twigs of the short saphenous nerve are distributed is a favorite seat of morphœa. The patches are of a dead white or yellowish color, often bordered by a pinkish zone, and on superficial examination they may be easily mistaken for scars. After the disease is fully developed, recovery may take place without leaving any trace of the affection, although unfortunately the disease does not tend toward recovery. The course of the disease may extend over several years, and although it does not itself often lead directly to death, it predisposes to acute diseases such as rheumatism and acute inflammations of the respiratory tract, and these, because of the patient's emaciation and vital depression, are very apt to lead to a fatal termination.

Treatment.—The object of treatment should be to invigorate the patient, to pay especial attention to the nutrition of the skin and neurovascular system, and to avoid factors that are known to aggravate the disease. Careful attention to diet, exercise, and hygiene, combined with the administration of such restoratives as arsenic, iron, and cod-liver oil, and the utilization of massage and hydrotherapy, will best meet the first indications. Electricity by means of the constant current of slight intensity, three to four milliamperes, over the sclerodermatous areas, followed by an application of two-per-cent salicylic vaseline thoroughly rubbed in, sometimes seems to have much beneficial effect. Life in the open air, in a salubrious equable climate, careful avoidance of exposure to wetting and chilling, will best obviate the causes that aggravate the disease. Patients who are subjected to the discipline of hospitalization seem to thrive very well. A number of cases have been reported in which the administration of thyroid extract has seemed to be of great benefit. But like in all other conditions in which this substance has been found useful, the disease recurs soon after administration of the thyroid is stopped. The general treatment of the disease may be said, in brief, to be not unlike that of chronic rheumatoid arthritis.

CHAPTER XL.

THE TREATMENT OF PROGRESSIVE FACIAL HEMIATROPHY.

Progressive facial hemiatrophy is characterized by a progressive wasting of one side of the face in which all the structures participate in a varying degree, the muscles least, the skin, subcutaneous tissues, and bone most, sometimes associated with hemiatrophy of the tongue. The disease occurs in children and in youths of both sexes, very rarely in late adult life. It has followed local trauma, exposure to cold, and the infectious diseases, such as influenza, erysipelas, and typhoid fever. It occurs most often in people who have some inherited or acquired neuropathic condition. It may occur in connection with scleroderma and with Addison's disease. In a number of instances it has been associated with lesion of the fifth nerve.

The disease usually begins with more or less pain in one side of the face, then the patient notices one or more whitish spots on the lower jaw or near the orbit, which gradually become larger or coalesce. The skin over these patches sinks and forms pits or troughs due to disappearance of the subcutaneous fat. Coincidently with this there is pigmentation of the face, irregularly distributed. The atrophy involves the skin, its appendages, and the tissues beneath it. The hair of the face, the head, and the eyebrows loses its color and falls, forming irregular areas of alopecia. The sebaceous glands are atrophied, and their secretion is diminished and eventually suppressed. The amount of perspiration is normal or increased. After a variable time, the entire half of the face becomes involved and a deep fissure, like a sabre cut, in the centre of the forehead and chin separates it from the healthy side. Rarely are both sides of the face involved. As a rule, there are no disturbances of sensibility. Local itching is frequently present, and the atrophied skin oftentimes gives the feeling as if a rubber mask was stretched across the face. Occasionally there is tonico-clonic twitching of the muscles supplied by the third branch of the trifacial nerve. Neuroparalytic symptoms pointing to involvement of the superior cervical ganglion and the carotid plexus, such as pin-point pupil, flushing of the face, and hemi-hyperidrosis have occasionally been noted. The course of the disease is at first rather rapid; then its progress may cease for a long time, to be followed sooner or later by a period of exacerbation. The prognosis as regards recovery is unfavorable, although the disease does not seem to shorten life.

Treatment.—As the disease is incurable, preventive treatment if possible, in the shape of early discovery of the cause and its removal, is of the greatest importance. Some authors have suggested that the area in which the atrophy manifests itself should be cut out as soon as possible, but I am at a loss to understand how such a procedure could be of benefit. Others have suggested early resection of the branches of the trigeminal nerve. There are no records to show that this plan has ever been tried. The use of galvanic electricity helps to stay the progress of the disease in some instances. In general the treatment is the same as that for scleroderma. To overcome the cosmetic defect when the disease has come to a standstill, the patient may have a plate made by a dentist, which can be attached to the teeth of the upper jaw on the affected side with a slightly convex surface against the mucous membrane of the teeth. This can be worn with comfort after the patient accustoms himself to it, and it detracts enormously from the unsightly deformity.

Hemihypertrophy and Local Hypertrophy.

Hemihypertrophy of the face and hypertrophy of an extremity or one-half of the body are extremely uncommon conditions which are usually considered under the trophoneuroses, although nothing is known of their origin or pathogenesis. Unilateral hypertrophy, limited to the head and face, occurs less frequently than hypertrophy of one-half of the body. It has occurred associated with inveterate neuralgia of the fifth nerve, with gigantism, and congenitally. It involves all the structures of the hard and the soft parts, although the hyperostosis is more prominent than the hypertrophy of the soft tissue. The course of facial hemihypertrophy is, as a rule, a progressive one during the years of normal growth, but after adult age is reached its progress is very slow. No form of treatment has been suggested that is of any use, although when its occurrence would seem to be associated with irritation of the fifth nerve, the latter should be resected. Hypertrophy of an extremity and general hemihypertrophy is a congenital condition, save in those instances in which the local hypertrophy is compensatory.

CHAPTER XLI.

THE TREATMENT OF ERYTHROMELALGIA.

ERYTHROMELALGIA is the name given to a peculiar red neuralgia first described by S. Weir Mitchell in 1872. As the name indicates, the disease is characterized by the occurrence of pain and redness, which affects principally the distal part of the feet, much less often the hands. Pain is the first manifestation, then redness, and finally swelling. The pain is of neuralgic character, usually intermittent in the beginning and especially liable to occurrence after considerable use of the feet, and toward evening. It is increased by standing, walking, hanging of the feet, and by warmth. The pain may have lasted for a considerable time before the redness appears, but usually the latter is well manifest when the patient consults a physician. It is associated with pulsation of the arteries, with a dark reddish-purple color of the skin, frequently with distention of the veins, and it is accompanied with local elevation of temperature and hyperidrosis. Sensory disturbance is usually absent, although tenderness of the parts, increased by pendency of the extremities, is the rule, and paræsthesia is not uncommon. It is associated with various general symptoms such as gastro-intestinal disturbance, headache, vertigo, cardiac palpitation, attacks of unconsciouness, and general myasthenic symptoms. The disease is liable to prolonged remissions, and its duration may be over a great number of years. Unlike the majority of vasomotor neuroses, it occurs predominantly in males, especially during the years of young and middle adult life. A neuropathic predisposition is traceable in most cases. Exposure to cold, hard manual labor, excessive indulgence in alcohol, previous existence of an infectious disease, including syphilis, have been considered causal agencies in different cases. The symptom complex may occur with hysteria, syringomyelia, Raynaud's disease, hemiplegia, and with muscular dystrophy. It is highly probable that erythromelalgia is not an individual disease, but a symptom complex associated with and dependent upon some organic and functional disease of the central or peripheral nervous system. So far post-mortem examinations and the examination of excised tissue during life have not been very numerous. Those that have been made seem to show that in cases of long duration, at least, there is marked degeneration of the blood-vessels, characterized by thickness of the media and interna, and degeneration of the peripheral distribution of the nerves, associated with increased formation of connective tissue.

Treatment.—The treatment of erythromelalgia will depend very largely upon the condition with which it occurs. As it is most frequently associated with degeneration of the blood-vessels, medicinal and dietetic measures appropriate for this condition must be adopted. Unfortunately, it usually resists all kinds of treatment, although it is generally ameliorated by measures that increase the patient's general health and strength. Elevation of the feet and the application of cold usually give temporary relief. Whenever it is possible, the patient should be advised to take a prolonged rest, to keep off the feet as much as possible, and to go through a mild hydriatic restorative treatment, combined with the use of measures that have been found beneficial in neuralgic conditions. It has been suggested by Mitchell that the posterior tibial nerve be excised as a means of relief, and in one or two cases this radical measure has seemed to be successful. Dehio has also recorded a case in which extirpation of the ulnar nerve caused the manifestations of erythromelalgia in the hand to disappear. When the symptom complex is associated with elicitable functional or organic disease, measures should be directed toward the cure or amelioration of these conditions. Endeavor should be made to allay the pain by the use of the faradic current and by administration of the modern analgesics.

CHAPTER XLII.

THE TREATMENT OF ACROPARÆSTHESIA.

Acroparæsthesia is the name given to the occurrence of paræsthesia in the extremities, unassociated with organic or other functional nervous disease. The condition has been described in this country by Putnam, Dana, and others as "the paræsthetic neurosis," and in Europe by Nothnagel and others as "the vasomotor neurosis of the extremities." The clinical picture is somewhat as follows: The sufferers from this affection are in fairly good health, except for the paræsthesia, consisting of a numb feeling in the extremities, especially of the hands, a sensation of pins and needles and formication, associated with more or less profound feeling of weight, unwieldiness, and diminished dexterity. These sensations are not limited to the distribution of a single nerve, but they are apt to be most severe in the finger ends. There is rarely any pain. Objectively, sensibility is intact or very slightly diminished. The skin is sometimes cool and relaxed, and the pulse lacking in vigor. There is no tenderness on pressure over any of the nerves and no perceptible atrophic or degenerative changes are noted. The affection is liable to show itself intermittently in paroxysms, and the period of the twenty-four hours when an attack is most likely to occur is from four to six in the morning. The causes of the disease are not definitely known. It occurs in women about five times as often as in men, and especially those who do washing, scrubbing, and needle work. It is seen more frequently during middle adult life than at any other time. Occasionally it seems to stand in causal relationship to the exhaustion following pregnancy, to lactation, the acute infectious diseases, and intestinal auto-intoxication. Many of the patients take tea, and some of them other stimulants and narcotics excessively. Occasionally it complicates emotional and neurasthenic states. Rarely is it found associated with marked arterial degeneration. The paræsthesiæ of rheumatism, gout, and arthritis are not considered under this heading.

Treatment.—Causal therapy is most important. An investigation of the patient's mode of life and occupation will usually reveal the factors that are apparently the excitants of the disease; and their removal or avoidance combined with a tonic and restorative plan of treatment, if it is persisted in, will suffice to overcome this distressing ailment. Prolonged rest is undoubtedly the most important agency, but unfortunately this is not possible for the majority of the patients. When it is possible, it should

be combined with regulation of the diet, especially with limitation of the nitrogenous foodstuffs, change of occupation and habits, and the administration of such restoratives as arsenic, phosphorus, strychnine, and iron. Ergot has been recommended, but I have seen no benefit attend its administration. The paræsthesia can usually be temporarily relieved by the use of the faradic current and by the application of lukewarm water to the extremities. The faradic current may be employed in the shape of the faradic local bath. Galvanization of the cervical spine and the sympathetic plexuses also often has a beneficial effect. When the attacks occur in the early hours of the morning and awaken the patient, much benefit is to be derived from the administration of a mild hypnotic at bedtime, such as ten grains of sulfonal or trional, taken with a considerable quantity of warm milk. Occasionally, treatment directed immediately to the overcoming of the uric-acid diathesis, indigestion, and malarial infection, has seemed to be very beneficial. When such indications for specific therapy exist, they should be met; but as a general rule the treatment that is most successful is the general tonic treatment applicable to neurasthenia.

CHAPTER XLIII.

THE TREATMENT OF OCCUPATION NEUROSES.

(Occupation Spasms, Cramps, Pains, and Paralysis.)

The name occupation neuroses is applied to a number of disturbances of mobility and sensibility of the extremities, particularly of the hands, developing after persistent use of the extremity at certain occupations or professions which call for the protracted use of a group, or associated groups of muscles. Neuroses resulting from the injurious activity of poisons encountered in the occupation are not considered occupation neuroses. The occupation neuroses, manifested as pain, spasm, or cramp-like condition in individual muscles or groups of muscles that act together in the performance of certain acts of co-ordination, or as an inactivity of these muscles amounting to paralysis, occur in scriveners, telegraph operators, pianists, milkers, tailors, golfers, cigarette rollers, smiths, ballet dancers, drummers, buglers, bowlers, and in hatters and pressers who work with a heavy iron. The number of these occupation neuroses would seem to be on the increase as human ingenuity devises new sports or labor requiring for their indulgence and performance complex co-ordinated muscular activities. Writer's cramp, graphospasm, or mogigraphia, as it is sometimes called, has been and is yet in some countries the most common type of occupation neuroses. In this country, however, where the typewriter has replaced to such a large extent the scrivener, writer's cramp is very uncommon to-day in comparison with a few years ago.

For a long time the occupation neuroses were considered to be an expression of local fatigue and exhaustion, manifesting themselves in peripheral parts, such as the muscles in which the pain, spasm, or paresis occurs. This view has been assiduously promulgated by vendors of apparatus to overcome the spasm or cramp which is the most distressing symptom of writer's cramp. Although there is a local or peripheral fatigue and exhaustion, this is not alone the result of the labor that such parts have performed, but it is an expression of an inherited or acquired constitutional neurosis which is now revealing itself on account of the depression attending persistent and fatiguing labor. Such a neurosis has no individual anatomical seat. The occurrence of these occupation neuroses in individuals who show other evidence of nerve instability, such as tic, migraine, neuralgia, and not in those of robust constitution and vigorous health, and their association with symptoms of neurasthenia and hypo-

chondria, such as headache, depression of spirits, insomnia, and general deterioration of neuromuscular tone, testifies that the condition is a constitutional one with a local display occurring under the auspices of exhaustion. The treatment of an occupation neurosis can be permanently successful only when this conception of its pathogenesis is borne in mind, and the plan of treatment based upon it. The local treatment of such a condition as writer's, telegrapher's, pianist's cramp alone is rarely if ever sufficient to effect a cure. It may cause temporary alleviations, but the manifestations of the disease are sure to return. The earlier the occupation neuroses are diagnosticated and treated the greater the prospect of effecting a permanent cure. Before beginning the treatment of an occupation neurosis all sources of peripheral causation, such as myositis, inflammation of a tendon or its sheath, cicatrices, etc., should be searched for, and overcome if found.

Treatment.—In speaking of the treatment, writer's cramp may be taken as a type of this class of disorders. The most essential feature in the treatment of these affections is cessation of the occupation which is the immediate cause of its occurrence. Successful results attend the cases in which this is insisted upon from the beginning. Oftentimes to relinquish one's occupation means to give up one's livelihood, but it is far better to do this at a time when the patient has the capacity to turn to something else than to wait until symptoms of neurasthenia and hypochondria, which are sure to develop, suffice to unfit him for any occupation, or until the muscles that are the seat of cramp begin to atrophy. Valuable time is often lost in the beginning by the trial of such makeshifts as apparatus for writer's cramp, and learning to write with the left hand. Unless treatment to improve the general health is applied simultaneously the beneficial results of such measures are merely temporary. The cramp will be sure to recur in the hand that wears the apparatus or in the hand that is being taught to hold the pen. Naturally, if the physician is consulted early, he may counsel the use of large penholders or some apparatus that prevents the muscles from getting into such a state of contraction that cramp occurs, and if at the same time active treatment by hydrotherapy, exercise, local and general gymnastics, massage, electricity, and tonics, is directed especially toward the strengthening of the muscles that become cramped, it may not be necessary to give over completely the occupation. It will be an economy of time and money to do so for a short time in the majority of cases. After the patient has ceased from the labor or pleasure that has led up to the spasm, he should be put through a restorative plan of treatment not unlike that employed for other neuroses such as neurasthenia and hysteria, the object being to improve the nutrition, increase bodily weight, secure refreshing sleep, develop muscular strength, and restore the equilibrium between production and expenditure of energy.

Coincidently with the utilization of means to improve the general

nutrition, measures should be employed to strengthen the parts which are or were the seat of cramp, and of these the most important are local gymnastics and resistant exercises of the individual muscles of the forearm, hand, and fingers. Slight massage of these parts should be practised persistently.

Treatment directed toward the relief of the spasm should consist in enveloping the hand and forearm in a cold wet pack once or twice a day; the use of the galvanic current, three milliamperes directed through the brachial plexus, the positive pole over the latter, the negative at the back of the neck, for from fifteen to twenty minutes each day; and the administration of such sedatives as hyoscyamus, belladonna, bromides, chloral, and valerianate for a brief time for their sedative effects. It has been stated in some cases in which the tetanic spasm resisted all these measures that the injection of strychnine into the contracted muscles has been efficacious. It is difficult to understand how such a substance as strychnine acts to overcome the spasm, but there is no objection to using it when the other measures fail to bring about the desired results. Opium or its alkaloids are rarely indicated for the relief of pain.

The after-treatment of the occupation neuroses is very important, as the tendency to relapse always exists. A return to the occupation which excited the spasm should be delayed as long as possible, and at the slightest indication of the spasm the occupation should again be given up. The treatment of the various other forms of occupation spasms differs in nowise from that already detailed, except in so far as treatment may have to be directed toward the part in which the spasm occurs.

The treatment of occupation palsies calls for exactly the same therapy as the occupation spasms, save that in the former there are no indications for the temporary use of sedatives and pain-relievers. The exception to this rule exists in cases in which the palsy is the result of pressure encountered in the occupation. The treatment then is the same as for ordinary pressure palsies.

CHAPTER XLIV.

THE TREATMENT OF HEADACHE.

The term headache is an extremely comprehensive one. It may be applied properly to any form of pain in the head. To do so, however, is to confound unnecessarily manifestations of disease with individual disease. A radical and extremely important classification of headache is as follows: (1) Migraine: an individual disease like epilepsy; a neurosis of a degenerative type. (2) Neuralgia: including tic douloureux, supra-orbital, occipital, and nuchal neuralgia. (3) Symptomatic headache: an indication of functional or organic disease, traumatic, accidental, or inherent. (4) Idiopathic headache: a rare form of cephalalgia which has no determinable association with organic or functional disease. Here only the third and fourth varieties are considered, as the first and second are properly considered elsewhere under separate captions.

Headaches have been variously classified by different writers. Some believe that they are most safely interpreted when given topographical classification. Others contend that the character of the pain is the most reliable distinguishing feature, but the majority find it more satisfactory to classify headaches according to their causes and disease associations. Almost any form of classification may be made to serve a useful purpose. In my lectures I often refer to: (1) Headaches of early life, embracing the years up to puberty; (2) headaches of adult life; and (3) headaches of senility. Such a division has many advantages. It impresses particularly the fact that the majority of headaches occurring in childhood are those known as reflex and the autotoxic, that those of adult life are in the main symptoms of the functional neuroses and intoxications, while those of late adult life are usually expressions of arterial degenerations and the injurious actions of toxic agencies.

The two most important facts to keep in mind in endeavoring to interpret the significance of headache are, first, that it is an important symptom of a number of functional and organic diseases; and, second, that the location, character, and duration of the pain are oftentimes the means of suggesting the condition or disease upon which it depends.

Headache may be: 1. A symptom of functional nervous disease: neurasthenia, hysteria, epilepsy, and exophthalmic goitre.

2. A symptom of organic brain disease: meningitis, encephalitis, brain tumor, and brain abscess.

3. An indication of intoxication and infection. The sources of either of these may be endogenous or exogenous; that is, the intoxication or infection may arise from within the system, such as from diabetes, uræmia, and intestinal catarrh, or it may be introduced from without, as by alcohol, nicotine, the metallic poisons, the malarial plasmodia, and the acute infectious diseases.

4. Due to disturbances and diseases of the circulatory system, such as accompany the anæmia of aortic stenosis and regurgitation, pulmonary emphysema and consolidation, general anæmia and its different forms, and arterial sclerosis.

5. Due to causes that produce continued fatigue and exhaustion by indirect or reflex action, such as from insufficiencies of the ocular muscles, irregularities in the refractive apparatus, irritation of the peripheral olfactory and trigeminal branches, or irritation of any of the great plexuses of nerves. Headaches of this variety are usually called reflex. When properly interpreted, there is no valid reason why this term should not be applied to them.

6. Due to trauma: traumatic headache. Headache may be the sequence of an injury that produces surgical conditions, such as wound of the scalp and bones, and it may follow trauma to the head which does not produce such injury. The explanation of the former kind does not seem a particularly difficult matter, and as for the latter, it is probably a variety of traumatic neurasthenia, occasionally pachymeningitis.

7. A local manifestation of rheumatic involvement of the epicranial and circumcranial tissues.

8. Finally, headache may be the expression of a pain habit, and to this the name habitual headache is given. In other words, after the occurrable headaches are parcelled out among these various diseases, there remain a small number that cannot be allotted to any one of them. It is more than probable that the headaches grouped under the heading of habitual headache are indicative in reality of a congenital or degenerative form of neurasthenia, and it is very questionable whether it should receive consideration apart from this group.

With this classification in mind, it becomes necessary to consider the characteristics of headache accompanying each of these diseases and classes of disease. By far the most important disease of which it is a symptom, because the most common, is neurasthenia. It is not at all improbable that nearly forty per cent of all headaches of sufficient intensity and duration to demand treatment are a symptom of the neurasthenic state; in fact, we are justified in saying that all headaches of an intractable nature, and extending over a prolonged time, are neurasthenic, with two exceptions: those due to brain tumor and to meningeal syphilis. The characteristics of neurasthenic headache are: (1) The location, on top of the head or encircling the head. (2) The character of the pain, pressure

feeling or drawing sensation. (3) The time of its occurrence, or, better said, exacerbation, for it is usually present continually to a certain degree. The patient awakens with headache, and it continues more or less during the day, wearing off toward evening, being submerged by those pleasures or indulgences that increase general neural tone. Its disappearance coincides with the feeling of moderate well-being which most neurasthenics have in the evening. (4) The fact that it is made worse by fatigue, mental exertion, and excitement. Sufferers with this form of headache are extremely voluble concerning their ailments. They harp on the different manifestations of their infirmity, and have a decided inclination to hypochondriasis. Such patients ordinarily present the usual slight physical accompaniments of neurasthenia: relaxed tonus of the skin, fine tremor of the extremities, particularly of the hands, excitable but easily exhausted muscle and tendon reflexes such as the knee jerks, and evidences of disordered digestion, impaired assimilation, and constipation.

Hysterical headaches are, compared with the variety just considered, very uncommon. Their diagnosis rests first upon the nature and seat of the pain, the classical form being that of a nail driven into the head, usually the supreme vertex, and its association with the bodily and mental stigmata of this neurosis. The more important of these stigmata are: hyperæsthesia or anæsthesia in the sensory sphere and special senses; hysterical tremors, spasms, or contractures; hysterical palsies; limitations of the intellectual sphere, obsessions, compulsions, and defective inhibition.

Headache accompanying the neurosis known as epilepsy is an extremely important symptom. Temporally, it may be preconvulsive, post-convulsive, or the convulsion equivalent. It is characterized by unheralded onset, by extreme intensity, and by an abrupt termination, followed by a period of great mental and physical exhaustion. Preconvulsive epileptic headache may be brief and of the nature of an aura. In such case it is followed by a convulsion, except in instances in which prompt and vigorous measures are taken to thwart the explosion. It is particularly those cases in which the headache is the equivalent of a convulsive attack that are followed by great prostration. The post-convulsive headaches are characterized by a feeling of soreness in the head, undefinable and unlocalized, and by more or less mental confusion. Both of these disappear as the headache passes off. All cases of idiopathic headache occurring in childhood and early adult life having some or all of the characteristics just enumerated, should be investigated most carefully and assidulously to determine whether or not they belong in this category.

Headache attending exophthalmic goitre is in its nature of two kinds, toxic and neurasthenic. The latter element is, I believe, the more important. The entire symptom complex of exophthalmic goitre is practi-

cally that of a profound state of neurasthenia. Whether this neurasthenic condition is primarily or secondarily toxic does not here concern us. The headache which accompanies this disorder is characterized by its vertical and frontal location, by its throbbing, pulsating character, and by its amenability to measures that contribute to general repose and to slowness of the heart's action. It is aggravated by anything that produces the antithesis of these. Its diagnosis offers but little difficulty, save in those cases in which the headache is a precursor of the pathognomonic accompaniments of this disorder.

The most important organic disease of the brain and its coverings attended by headache is tumor, and it matters not very much what the nature of this neoplasm may be, although its location stands in some relationship to the nature and seat of the pain. The character of the pain of brain tumor is a very variable quantity. In one case it is of a boring, gnawing character, in another of a distending, skull-splitting kind, while in a third case it is a dull, consciousness-benumbing ache. In all cases persistence is one of its most striking characteristics, especially in the beginning of the disease. Later on, when the sensorium becomes so benumbed from intraventricular distention that pain does not enter as a qualé of consciousness the patient ceases to complain. It is exacerbated by anything that jars the head, such as tapping, coughing, sneezing, and bodily agitation, and by everything that increases blood pressure or a determination of blood to the head. The pain is local or diffuse, and rarely does it correspond to the seat of the tumor or indicate its location. Tumor of the cerebellum, however, almost invariably is accompanied by headache, located in the occiput or the forehead. The occurrence of headache of the kind above described can only suggest the existence of brain tumor; its association with other symptoms makes the diagnosis.

The headache of brain abscess is not particularly characteristic. It may be said, however, that it is persistent; severer during the early night than the early day; increased by coughing, jarring, and stooping; entirely unamenable to any medication, and generally accompanied by corresponding and increasing mental obscuration. It is not infrequently localized, particularly when the brain abscess is of otitic origin, but in many cases the patient locates the pain remote from the seat of the disease. It is diagnostically significant only when associated with the known etiological and symptomatic features of the disease.

The headaches of acquired hydrocephalus, of encephalitis, and of disease of the cranial sinuses have nothing pathognomonic about them. They assume importance only when associated with other and more significant symptoms, such as vertigo, vomiting, convulsions, and paralysis, for hydrocephalus; the manifestations of inflammatory phenomena, for encephalitis; and the accompaniments of an infection or marasmic condition, for sinus thrombosis. Headache accompanying the latter disease

is, however, almost invariably localized to an area corresponding to the seat of inflammation.

The headaches of meningitis cannot be easily and satisfactorily disposed of in a few words. Every practitioner knows that all the varieties of leptomeningitis are attended by severe headache, and that such pain has a number of distinguishing features and associations. The pain is of acute onset, of a boring, unendurable character, which causes the sufferer to shriek out in his sleeping as well as in his waking moments. It embraces the entire head, shooting from one location to another, and it is accompanied by such diagnostic symptoms as nuchal rigidity, localized and general spasm, pupillary inequalities, elevated temperature, and finally paralytic phenomena. In tuberculous meningitis the headache is not so intense as in some of the other forms of leptomeningitis, and it is often times localized in the occipital and cervical regions, while the pain of purulent meningitis is more often frontal than occipital.

The common forms of pachymeningitis are those due to syphilis and to trauma. They are both accompanied by intense headache, which is due to compression of the dural nerves. Both tradition and experience have it that the headache of syphilitic pachymeningitis is apt to be localized to a very small area or to involve the entire occipital or upper cervical region. The pain is not continuous, is sometimes worse at night, and is exacerbated by intellectual effort and by everything that increases the intracranial blood supply. Headache of pachymeningitis cannot be distinguished, from a consideration of this symptom alone, from cephalic pain caused by such a condition as enlargement of the pituitary gland in acromegaly.

The headaches of circulatory disorders are not so common numerically as one might be led to suppose from reading the chapters on these diseases in the text-books. A decade or two ago cerebral anæmia and hyperæmia received a disproportionate and undeserved amount of attention, both from the neurologist and the general practitioner. Their occurrence, it was thought, was quite an every-day affair, and a fanciful, intricate symptomatic superstructure was erected to encompass their subjective and objective accompaniments. To-day it is wellnigh universally conceded that neither of these conditions occurs as an individual state apart from pathological conditions in other parts of the body. Undoubtedly, a condition of cerebral anæmia is a common dependency of aortic stenosis, and of mitral regurgitation when the latter goes uncompensated. On the other hand, pulmonary emphysema, pulmonary atelectasis, a prolonged paroxysm of pertussis or asthma, disease of the right heart, may and do produce difficulty of egress of the return circulation, and thus a state of hyperæmia, but no one will be likely to contend that the cerebral anæmia or hyperæmia thus induced is an individual disorder. On the contrary, these factors are parts of the morbid entity. It is very possible that

prolonged and intense excitement, such as that of acute mania, the taking of large quantities of cardiac and vascular stimulants, and possibly great physical effort, may determine a disproportionate amount of blood within the cranium, but the facilities for adaptation provided by the enormous lymph cisterns soon equalize this, and prevent it from becoming sufficiently permanent to constitute the basis of symptoms.

Headache is a common accompaniment of symptomatic cerebral hyperæmia and anæmia, and of general anæmia. Its indicativeness is suggested by association with other symptoms. When the diagnostic value of the locality of cephalic pain is spoken of, it will be seen that headaches of general anæmia are usually confined to the forehead and eyes, and associated with a more or less sharply defined area of occipital pressure. Such headache is in reality a form of neuralgia, in the majority of instances conditioned by want of nourishing blood supply to the trigeminal and occipital nerves. The pain of anæmic headaches is a variable quantity, but sometimes it is of almost intolerable severity. The patient is rarely completely free from it. Its character is that of a heavy pressing sensation, but at the periods of its exacerbation it is throbbing, and relieved by external pressure. The headaches that accompany chlorosis, progressive pernicious anæmia, and leukæmia have no striking characteristics that differentiate them from general anæmic headaches. The headaches attending leukæmia are not so intolerable, notwithstanding the gravity of this disease, as those of general anæmia and chlorosis.

Headache due to organic disease of the blood-vessels, arterial sclerosis, is associated with other very significant symptoms, a consideration of which readily makes the diagnosis. These are vertigo, slight syncopal attacks, disorder of the nutritional equilibrium, changes in the blood-vessels, detectible to the touch and to the eye, slight mental deterioration, and general lowered vitality. The headache is usually of a throbbing character, not infrequently associated with sounds and noises in the ear, a sensation as if the head were being drawn forcibly backward, and with a feeling of portentous dread. It is increased by everything that increases blood pressure and by everything that diminishes vital force.

The headaches that are grouped under the caption of reflex headaches are a very important class, not so much because of their frequency, but because of the fact that they are extremely amenable to treatment if interpreted early; and extremely sluggish to any therapeutic response if they have been allowed to go on for a long time. In other words, if they are attacked before a headache habit is formed, remedying the conditions on which they are dependent suffices to cure in the vast majority of cases. If they are not, such orthopædic measures only alleviate but do not cure. By far the commonest cause of reflex headache is improperly implanted or innervated musculature of the eyes and defect in the refractive media. The headache which these two conditions cause is in reality an exhaustion

headache. If it continues for a long time it is almost impossible to differentiate it from neurasthenic headache. If some of the muscles of the eyes are so deficient congenitally or as the result of disease that a strain is continually put upon other muscles in order to cause normal binocular vision, or if the cornea and crystalline lens are so ill prepared for their function that they do not focus parallel rays of light immediately on the retina save by the effort of muscles to change their radii of curvature, then the strain thus caused induces after a time a state of profound neural exhaustion which is manifest by headache. This headache has usually the following characteristics: It is limited to the forehead or to a very circumscribed spot in the occiput; it is made worse by use of the eyes, and it is remedied by resting the eyes and by anything that temporarily paralyzes accommodation. It is never present on arising in the morning, and one of its most striking features is that it is strictly sabbatarian. Fortunately ordinary routine examination is often all that is necessary to show the shortcomings of the peripheral ocular apparatus and to indicate the necessary measures to overcome it.

The next most common variety of reflex headache is from the pelvic organs, and this variety of headache is peculiarly an exhaustion headache. It is not met with nowadays one-half so often as it was in those times when it was the vogue to tinker with the generative organs of the female. Reflex uterine headache has been expiated at the shrine of the modern, non-meddlesome gynæcologist. Headache associated with posterior displacements of the uterus and cervical lacerations—two important causes of uterine headache—is usually neuralgic in character, its favorite location being in the occiput. Such cephalalgia is often associated with tenderness on pressure in the cervical region, and with "weak back."

Judging from my own experience as well as from the statements of rhinologists, headache associated with disease of the nasal passages without involvement of the frontal sinuses and ethmoiditis is not very common, although some nasal specialists would have us believe that more than three-fourths of all headaches, including migraine, are due to disorder of the nose. The intemperateness of such a claim shows that the one who makes it has his visual horizon limited to the field of the nasal speculum. Nasal headaches are usually due to irritation of the branches of the trigeminal nerve, caused by swelling of the mucous membrane and deformity and hypertrophy of the nasal walls. It is frontal in location, usually above the root of the nose, of a dull, boring character, oftentimes relieved by gentle frontal pressure and temporarily lessened by sniffing pungent aromatic substances. It is more or less continuous, but very liable to paroxysmal exacerbations. It is worse in the morning immediately on arising, and usually it diminishes materially after the patient has had his bath, breakfast, and anything else that improves the general circulation and temporarily invigorates. If dependent upon ethmoiditis or

disease of the frontal sinus the accompaniment of swelling on the orbital surfaces of the nose and the discharge are important. Headaches that are reflex from the ear are very uncommon, and when they occur they have no distinguishing features, save the location in the mastoid and temporal regions.

Headache reflex from other sources, such as from the sexual organs of the male, are oftentimes subjective states of consciousness on the part of the diagnostician.

Headaches of toxic origin, using the word toxic to cover endogenous and exogenous sources, have little in their localization or character to distinguish them from other headaches. The fact that they occur in persons who use tobacco, alcohol, tea, drugs, etc., and in those who are exposed to the absorption of lead, carbon dioxide, mercury, phosphorus, and other metallic poisons, leads one to suspect their true origin, while the presence of other more characteristic features of such intoxication attests the diagnosis. Like the headache of autotoxæmia, particularly those associated with intestinal catarrh, they are oftenest located in the front of the head, and described as heavy-pressure feelings, though sometimes they are of a throbbing nature made worse by anything that disturbs the vascular circulation. The metallic poisons arsenic and iodine produce a very characteristic feeling of suffusion in the forehead, while lead, on the other hand, frequently causes a diffuse pain extending over the entire cranium, but occasionally confined to one spot in the distribution of the trigeminal nerve. More than a few varieties of headaches are associated with disorder of the digestive apparatus. Four factors enter ordinarily into their production: (1) The absorption into the system of products of incomplete digestion and assimilation, which, in the process of metabolism, principally in the liver, result in the formation of alkaloidal substances having toxic properties; (2) diminution of blood pressure apart from that produced by the action of the resulting leucomains and ptomains; (3) general and local anæmia, which is almost invariably an accompaniment of indigestion; and (4) reflexly, from distention of the gastric and intestinal walls. These headaches are usually frontal, often located immediately above the eyebrows, and the patient describes the pain as a confused, apathetic feeling, with exacerbations of sharp pain. It is almost invariably worse in the morning, and is frequently relieved by purgation or by vomiting. The diagnosis is to be made from the condition of the patient's breath and tongue, from the accompanying phenomena of disordered stomachic and intestinal digestion, and finally, if necessary, by the administration of a test meal, its removal and analysis. Headache that accompanies an attack of acute indigestion varies in its localization, character, and intensity with each patient. In my experience the commonest location is the anterior half of the head; the pain is of a throbbing character synchronous with the heart beat, and it is made very much worse by physical

activity, and especially by sudden changes in the position of the body. It is often associated with a sensation of a collar or band bound tightly around the neck, with flushing of the face and slight injection of the conjunctiva. A form of intestinal trouble which sometimes produces headache in children is the presence of parasites. The diagnosis is to be made only when the parasites are found in the stools.

Headache is the commonest forerunner of the infectious diseases, but with the exception of a few, such as syphilis, malaria, typhoid fever, influenza, and epidemic cerebrospinal meningitis, they have no distinguishing features. Headache is an extremely important accompaniment of syphilitic disease, and it shows itself either during the period of eruption, or as a symptom of late syphilitic manifestations. The headache of the eruptive period may be distributed over the entire head, or limited to the occiput. Very rarely does it reveal itself as hemicrania. It is not distinguished so much by its location as it is by the fact that it occurs usually at night, or is very much worse at this time. During the day it diminishes in severity or disappears. It is not infrequently accompanied by manifestations of frontal or parietal periostitis, discernible to the sight and to the touch. Headache accompanying the later stages of syphilis is perhaps of even more frequent occurrence. Although it has a decided predilection to be worse at night, it is more readily recognized by its association with vertigo, slight dementia, paresis, or spasm of the musculature of the cranial nerves, and by other irritative and paralytic phenomena which pursue an extraordinary course, than by any other feature.

It was formerly thought that headache of malarial infection was usually a neuralgic-like pain over the eyebrows, having as a striking feature its periodical occurrence, but the recent experiences of our citizen soldiers in the tropics have shown that at least the headaches of acute malarial infection have no diagnostic features. It is quite impossible to differentiate them from those of typhoid fever. It is probably true that the profound anæmia which is such a striking accompaniment of chronic malarial poisoning expresses itself oftenest in the nervous system by a neuralgia of the supraorbital nerve. But nowadays one would not be likely to make the diagnosis of malaria without having discovered some form of plasmodium in the blood.

The headache of epidemic cerebrospinal meningitis is so characteristic, both in its location and intensity, that it requires no detailed description.

The variety of headache known as habitual headache, or idiopathic headache, has very little in its location or in the character of the pain to differentiate it from neurasthenic headache, and, as has before been said, it is not improbable that it is in reality a manifestation of this disorder, although usually none of the somatic or psychical concomitants of nervous exhaustion are to be found.

Traumatic headache is so obviously dependent upon injury, and so

usually attended with its objective accompaniments that it requires no further mention. When persistent and rebellious to treatment, its association with localized pachymeningitis, or even graver diseases of the intracranial structures, should be borne in mind.

Rheumatic epicranial myositis is of more frequent occurrence than one would be led to suppose from the scant reference to it in the literature. It is accompanied by headache, and the same features as myositis in any other part of the body, and by such it is to be diagnosticated.

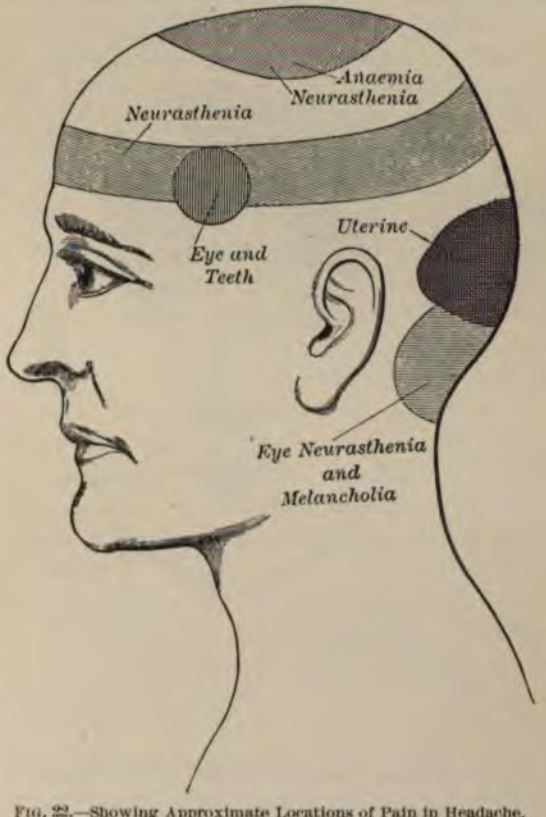

FIG. 22.—Showing Approximate Locations of Pain in Headache.

Much help in the proper interpretation of headache may be obtained from a careful consideration of its location. Not that headache due to an individual cause, such as eye strain for example, is always referred to the same area in the head, but if an average of all the cases of headache associated with such a condition is taken it will be found that the pain is localized by the sufferer either in the frontal or the occipital region. Instead of giving verbal description of the location of headache as a diagnostic indication, use is made of the accompanying diagrams (Figs. 22, 23), which are based on diagrams originally published by C. L. Dana. It should be borne in mind that these are somewhat schematic, and that the headache of a given area does not necessarily confine itself there, or manifest itself there on every occasion.

After all that has been said concerning the character, duration, seat, intensity, and diagnostic significance of headache, it may seem superfluous to pursue further the subject of diagnosis, but as the correct interpretation of headache is of paramount importance in determining the

successful treatment, it may not be amiss to say a few words more on th important phase of the subject. After the symptom has been considere from the points of view that have been mentioned, the eventual diagnos should be reached by process of exclusion. The first thing to do is t exclude the cephalic pains of neuralgia and of migraine. The pain whic we speak of as neuralgia of the trigeminal nerve, and of the occipital an the upper branches of the cervical nerves, is to be distinguished, first, b its location in the nerves and along the course; secondly, b the character of th pain, which is ofte of a sharp, unbearabl kind, relatively per sistent—that is, with out periods of inter mittency, and contin uous for a long time thirdly, by a sensi tiveness of the epi cranial structures, in cluding the hair, to which these nerves are distributed; and, fourthly, by the fact that this variety of cephalic pain is al most always relieved, temporarily at least, by hot applications.

FIG. 28.—Showing Approximate Locations of Pain in Headache.

Migraine is to be distinguished by the location of the pian, usually confined to one side of the head; by its association with nausea or vomiting; mental depression; vasomotor disturbances of the face, either flushing or pallor; hemianopic obscuration of vision, by flashes of light, phantasmagoria, or scotomata; vertigo; ringing in the ears; and occasionally with paralysis of one of the oculomotor nerves, all of which symptoms are made worse by the slightest physical or mental effort. They are often ameliorated, especially in overworked and intensely neurotic people, by taking small quantities of predigested or easily assimilated food and by diffusible stimulants in small quantities.

After the neuralgic pains and migraine have been excluded, it becomes necessary to establish the fact that the cephalalgia is not due to disease

of the epicranium and of the cranial bones and their cavities, such as rheumatic myositis, periostitis, caries and inflammation of the frontal sinuses. The first can be excluded by the local manifestations and by the association of other symptoms of rheumatism and uricacidæmia. Caries of the cranial bones and periostitis, be they syphilitic or traumatic, will be accompanied by etiological or symptomatic features that distinguish them, while the location of headache due to catarrh of the frontal sinuses, its association with disordered intonation, and its accompaniment of unilateral nasal discharge, will prompt the diagnosis. The headache of ethmoiditis, which is more common than generally supposed, is usually of a neuralgic nature, located in the frontal and intra-orbital regions, and accompanied by unilateral or bilateral swelling which is palpable on either side of the root of the nose.

Because headache is often the initial and the most conspicuous symptom of disease of the brain and meninges, painstaking care should be taken to exclude these diseases. Although headache is weighty above everything else in suggesting the presence of such disease, it is only when in association with vomiting, delirium, vertigo, convulsions, spasticity, nuchal rigidity, paralysis, and inflammation or atrophy of the optic nerve, determined ophthalmoscopically, that it has such dread import. After the process of exclusion has been brought thus far in the estimation of the kind of headache, it behooves us to give consideration to the organs of special sense, particularly the eye and the nose, to determine whether there be anomalies of refraction, muscular insufficiency, or organic disease of the eye, such as glaucoma on the one hand, or anything encroaching on the nasal passages on the other.

Finally, the circulatory apparatus and the blood should be investigated, after which sources and evidences of intoxications and infections, both within and without the body, are passed in review, leaving for final consideration the elimination of the neuroses, neurasthenia, epilepsy, and hysteria. It is not unlikely that when one is done with this painstaking process he will find that the last one considered is the category to which the headache belongs. Having his labor for his pains, he may console himself with the German proverb: "Uebung macht den Meister."

Treatment.—In view of all that has been said concerning the multifarious causes of headache and the widely varied conditions under which it occurs, it is not at all surprising that no individual or specific method of treating it exists. There is no ailment in the domain of medicine that requires more careful, searching investigation to elicit its causation and nature than headache. In order to treat it successfully, the physician must determine the morbid indicativeness of the symptom, then adopt measures which combat it. There seems to be a sort of traditional belief that certain drugs are more or less specific for headache. Implicit credulity of this kind accounts in part for many uncured headaches. At the

present day, when it is so easy to relieve pain temporarily by giving common analgesics, the temptation of the physician is to prescribe in routine fashion some of these temporizing agencies, trusting that nature will do the rest; while the habit of the patient is to go to the drug-shop and buy a headache powder. Although it is a just and legitimate procedure to quell pain promptly and at all hazards, it is no less incumbent upon the physician to try to prevent the recurrence of such pain. Treatment of headaches offers a splendid field for the exercise of such endeavor, and he who contents himself with giving phenacetin, antipyrin, the bromides, and the like, without seeking the ulterior cause and attacking it, is predestined to failure, and does both the patient and himself an injustice. The first duty when confronted by a patient suffering from headache is to determine to which of the four categories enumerated in the beginning of this article it belongs. Is it migrainous, neuralgic, symptomatic, or idiopathic headache? It is extremely necessary to make this distinction, for although the treatment of one variety may not be absolutely dissimilar to that for the other, to recognize it as belonging to one of these classes may immediately orient one not only as regards treatment, but as to prognosis as well. The next step is to determine the disease of which it is a symptomatic accompaniment. Then its treatment can be legitimately undertaken. To pass in review, even though briefly, the measures that have been recommended for the relief of this common disorder would be bewildering and unprofitable. I shall, therefore, speak only of measures with which I have had personal experience.

In brief, the treatment of headache presupposes the correct etiological diagnosis, which in turn depends upon a searching examination of every system of the body, and especially those systems that experience has taught us stand in frequent relationship to this symptom, and the use of temporizing measures. The latter are of very great value, and, fortunately, few in number. They may be conveniently referred to in four groups:

1. Drugs that are derived from coal-tar distillation and synthetically, possessed of analgesic properties: phenacetin, trophenin, exalgin, salol, and combinations of these with alkalies, such as antikamnia. 2. Drugs that are plant derivatives, acting principally upon the vascular system: caffeine, cannabis indica, and opium. 3. Mineral compounds, such as the bromides, acting principally upon nerve cells, and the salines, acting upon the circulatory fluids to produce watery evacuations. 4. Antispasmodics and paralyzers of striped muscular tissue, such as ethereal substances and belladonna. It is often necessary to give one or more of the constituents of these four classes; it matters not what the form or causation of the headache may be. Speaking generally, it may be said that those of the first class may be relied upon to produce an amelioration of the pain in all headaches, save those due to inflammatory disease and to pressure. Those of the second group are particularly serviceable in headaches accompanied

by marked deviation of blood pressure, caffeine being the symptom medicine par excellence in headaches associated with lower vascular tension, and cannabis indica in those associated with a pulse of high tension. The symptom medicines in the third group have a much more confined application. The class represented by the bromides have their chief use in epileptic headaches and headache with vasomotor symptoms, while the salines are narrowly confined in their usage to the headaches of auto-intoxication. The drugs of the fourth class are of use principally in headaches associated with spasmodic and fatigued action of peripheral muscular apparatus.

Headaches of the Functional Neuroses.—Unquestionably, the common form of headache that the general practioner is called upon to treat in this country to-day is, I think, that associated with the exhausted and irritable condition of the sympathetic and cerebrospinal systems known as neurasthenia. It is a variety of headache that is difficult to cure, especially the forms that develop in early life, and for which there seems to be no adequate determinable cause. These cases represent an inborn tendency toward neural instabilty. Headaches symptomatic of the neurasthenic state occurring in adult life and from determinable causes are usually quite amenable to treatment, while those occurring in later life, particularly if they are the expression of a second or third attack of neurasthenia, are very rebellious. The treatment of neurasthenic headaches consists in the removal of the causes and the adoption of measures directed immediately to the relief of the neurasthenic state. These measures comprise intelligent rest, exercise, sport, change of environment, which may mean simply change from home to a boarding-house, or vice versa, increase of nutrition through diet, and hydric applications, and in some cases the use of massage and electricity. The use of water in the treatment of neurasthenia is adequately discussed in the chapter on neurasthenia and need not be considered here. Headaches associated with increased vascular tension, flushing of the face, and throbbing sensations in the head, are often relieved by cold applications to the head, by wrapping the head in linen wrung out of cold water, and by the administration of a sitz bath, half bath, or a derivative foot bath. Sometimes they are quickly relieved by having the patient hold each foot successively from thirty to forty-five seconds in cold water as it falls from the tap. Neurasthenic headaches, associated with sleeplessness, are in my experience more quickly and wholesomely influenced by a full warm bath of from 96° to 102° F. to which from one to two ounces of pine-needle extract is added, and given just before retiring, than by any other measures. By a seeming contradiction in terms, rest for the neurasthenic patient often means considerable physical exercise, and the advent of golf and bicycling as fashionable indulgences have marked the rocks and bunkers on which many a neurasthenic headache has been shattered.

The treatment of functional symptomatic headache, be it neurasthenic or hysterical, by electricity is not a fruitful subject for discussion. Occasionally headache of this kind that maintains stubbornness to every form of therapy succumbs to sparks from the static machine administered through a coronal electrode. Occasionally, also, the administration of a very mild galvanic current of from one-half to one milliampere and of five minutes' duration, the positive pole at the back of the neck, the negative pole over the forehead, has been of service in headaches occurring with the depressed form of neurasthenia. The effect of the electricity is, I believe, to be attributed to suggestion. The medicinal treatment of neurasthenic, hysterical, and epileptic headaches is not so important as the general treatment save in the latter disease. In neurasthenic headaches associated with low vascular tension, caffeine, either alone or in combination, gives excellent results. The following formulæ I find particularly useful:

℞ Caffein. citratis, ... gr. v.
Sodii bromidi,
Sodii bicarb.,
Pulv. acid. tart., ... ãã gr. x.
M. ft. pulv. No. i. S. Take in water while effervescing.

Or:

℞ Caffein. salicylatis, ... gr. i.
Ammonii salicylatis,
Phenol. salicylatis, ... ãã gr. v.
M. ft. cap. No. i. S. One capsule every three or four hours.

Or:

℞ Caffein. pur., ... gr. ss.–iss.
Phenacetin, ... gr. v.
M. ft. cap. No. i. S. Take with hot water and repeat in one hour if necessary.

As a general pick-me-up and diffusible stimulant for neurasthenic headache, especially of women, the following prescription has served me well:

℞ Ammonii carb., ... ʒ iij.
Tinct. sumbul, ... ʒ vi.
Spts. lavandulæ, ... ℥ i.
Elix. ammonii valerian., ... ad ℥ viij.
M. S. Two teaspoonfuls every three hours in water.

Naturally these remedies are symptom medicines and they suffice only for amelioration and temporary cure. The administration of general tonics and nervines should not be neglected. One of the most satisfactory mixtures that I use in the depressed forms of neurasthenia, especially neurasthenic and anæmic headache, is as follows:

℞ Zinc. phosphatis, ... gr. ¼
Ferri reduct., ... gr. xx.
Extract. nucis vomicæ, ... gr. ij.
M. ft. pil. No. viii. S. One pill two or three times a day.

In headaches of a similar nature accompanied by considerable disturbance of the emotional life, that is, headaches having the character of neurasthenic headaches occurring in hysterical people, the following formula can be recommended after a number of years' experience:

℞ Zinci valerianatis,
Ferri sulphatis,
Ext. rhei,
Asafœtidæ, ... āā ℈i.
M. ft. pil. No. xx. One pill three times a day.

Before taking leave of this part of the subject I wish to say one word concerning the use of bromides in the headaches of neurasthenia and hysteria. It will be remarked, no doubt, that very little mention has so far been made of the salts of bromine. And this for the reason that it is my belief, as it is the belief of many neurologists, that bromides have been done to death in these disorders. I have no intention to deny the utility of the bromides in certain forms of neurasthenic and hysterical headache, for I am appreciative of their utility; but nothing has been more impressed upon me from my intercourse with physicians of experience than the fact that the abuse of bromides, especially in functional nervous diseases, is one of the evils of the time. There is no disease, with one and possibly two exceptions, these being epilepsy and migraine, in which it is justifiable to administer bromide for any considerable length of time. Nevertheless, it cannot be denied that many practitioners are either unwilling to subscribe to this view or they are heedless of such advice. There are certain cases of neurasthenic headache, especially those associated with general erethism and anorexia nervosum, in which the administration of bromides for a few days is extremely serviceable, and one of the most popular prescriptions at my clinic is the following, known as mistura nigra:

℞ Sodium bromide, ... ℥ ss.
Pepsin scales, ... ℈ ij.
Pulv. veg. charcoal, ... ʒ iiss.
Glycerin, ... ʒ ij.
Spearmint water, ... ad ℥ iij.
M. S. Teaspoonful two or three times a day after meals.

The headaches associated with the neuroses that are now being considered almost always occur in people whose digestive and assimilative functions are disordered and whose avenues of excretion are more or less sluggish. These disorders of function demand attention, but it is unnecessary, I believe, to make specific mention of the substances employed to gain such ends. What has been said for the treatment of neurasthenic headaches applies also to those occurring as a manifestation of the hysterical state; but the treatment of headache which accompanies the other two grand neuroses enumerated in the classification, viz., epilepsy and

exophthalmic goitre, requires very different drug administration, although the general dietetic, mechanical, and disciplinary measures are the same.

The most important fact in the treatment of epileptic headaches is that those which are the equivalents of an attack should receive the same careful, methodical, persistent bromide treatment as the convulsive form of epilepsy. The indications for medicinal treatment in the preconvulsive form of epileptic headache are to give diffusible stimulants, such as the nitrites, and if the cephalalgia precedes the convulsive attacks for any length of time a large dose of one of the bromide salts. Post-convulsive epileptic headache is best combated by some such diffusible stimulant as coffee given in the shape of a hot, black infusion.

The headaches of exophthalmic goitre—which, in reality, are not to be differentiated in their origin or in their manifestations from the headaches of neurasthenia, but which are always of a throbbing character—are best relieved by absolute bodily and mental rest, and by the administration of aconitia in $\frac{1}{200}$-grain doses, repeated every three or four hours if the vascular tension is high, or by the administration of digitalis or its alkaloid in full physiological doses if the pulse is of low tension.

The treatment of headaches accompanying organic disease may be dismissed after very brief consideration, for, as a rule, it may be said that operative interference is the only form of treatment in all varieties of organic headaches save those due to syphilis and non-pyogenic infection. The latter require treatment directed immediately against the causes.

Headaches of Infections, Intoxications, and Auto-intoxications.—The headaches of intoxications and infections may likewise be briefly dismissed. Those accompanying the infectious diseases do not call for any particular treatment aside from the measures taken to combat the infectious processes, while the treatment of headache due to the ingestion of vegetable or mineral poisons resolves itself into the very simple matter of preventing the further ingestion of the poison, be it tea, alcohol, tobacco, or poisonous substances administered therapeutically or encountered in occupations, and the elimination of any of the poisons remaining in the system from the body. After that, the headache disappears on the restoration of general, including neural, nutrition. To thus restore nutrition, general tonic treatment, very similar to that described under neurasthenia, is required. And meanwhile the headache may be relieved temporarily by the administration of some of the prescriptions possessing analgesic properties already mentioned. A formula that I often use as a general tonic and stimulant in headaches following the infections and exogenous intoxications is the following:

℞ Opii pulv.,
Zinci phosphid., ... āā gr. ss.
M. ft. pil. No. xx. S. One pill three times a day.

It is to me nothing less than remarkable the tonic effect which one

gets from this small quantity of opium. All the infections and intoxications, without exception, produce a more or less profound condition of general anæmia, and this anæmia must be reckoned with in estimating the nature and determining the treatment of the headache. Early in the treatment of such headaches some such searching tonic as the following should be administered:

℞ Ferri et ammonii citratis, ... gr. xl.
Liq. potassii arsenitis, ... ♏ xl.
Syr. zingiberis, ... ʒ ss.
Inf. calumbæ, ... ad ʒ iv.
M. S. Two teaspoonfuls after meals.

I am especially apt to give this mixture to children who complain of headaches following the infectious diseases, while for adults the mistura ferri et ammonii acetatis is substituted for the citrate salt.

In the treatment of headaches resulting from the absorption into the system of some endogenous poison, such as that of diabetes, uræmia, and the auto-intoxications and infections, the general measures to be adopted do not differ materially from those already spoken of. The headache is combated when the formation of the poison and its absorption into the system are interfered with. In this way diabetic headaches are treated by diet and by the use of remedies against the anæmia and oligocythæmia, while uræmic headache is combated by measures that prevent the formation of urea, and by those that facilitate its excretion. In uræmic headaches accompanying chronic interstitial nephritis of slow progression, I use the following prescription as a diluent and diuretic with good effect:

℞ Potassii citratis,
Tinct. hyoscyami,
Spt. etheris nitrosi, ... āā ʒ ij.
Inf. scoparii, ... ʒ vi.
M. S. Tablespoonful in water three times a day.

If it is necessary to increase vascular tension, infusion of digitalis may be added to this mixture.

Headaches arising from such intoxication as that of ammonæmia require local treatment of the cystitis, and the institution of measures to combat the coexisting anæmia.

Headaches arising from auto-intoxication, the original source of the disease being stomachic and intestinal catarrh, functional perversion of the glands supplying the digestive juices and of the liver, or through the activity of non-pathogenic bacteria, taken in from outside, form an important class, and one that is happily rather amenable to treatment. It must suffice for me to say that after the general measures for regulating the alimentary tract, and its associated functional dependencies (such as overcoming constipation, administration of suitable cholagogues and aperients, stimulating the liver to produce a suitable kind and amount of bile,

the giving of substances that aid in restoring the functions of the pancreas and spleen), the treatment consists in the administration of substances that correct the apparent trouble of digestion, and of those that quell the headache. A favorite prescription for headache associated with flatulency and pyrosis is the following:

℞ Sodii bicarb.,
Bismuthi subgallat.,
Pulv. acaciæ, ... ää ʒ i.
Liq. ammonii anisi, ... ʒ ij.
Aquæ dest., ... ad ℥ viij.
S. Two teaspoonfuls before meals, repeated in three hours if necessary.

In headaches associated with atonic dyspepsia, but without any considerable flatulency, I make use of the following pills, and especially in the headaches occurring in women:

℞ Ferri sulphatis,
Quininæ sulphatis, ... ää gr. xv.
Sodii arsenitis, ... gr. ss.
Pulv. rhei,
Pulv. zingiberis, ... ää gr. x.
M. ft. pil. No. xii. S. One pill three times a day after meals.

Headaches of Disorder of the Circulation.—The treatment of headaches due to disease of the circulatory system requires considerable discussion, not so much because of their frequency as because of the fact that if they are properly interpreted they yield readily to treatment. Headaches that accompany organic diseases of the heart, whether they be associated with excess or deficiency of propulsive power, naturally require treatment directed to that organ, as does any pulmonary condition which interferes with the return cerebral circulation. Headaches occurring with functional disturbances of the heart are oftentimes very amenable to therapeutic measures, not drugs. For instance, a heart that is working violently as the result of great physical effort or excitation of mind or body may be so quieted by the application of a simple cold-water compress to the cardiac region that the accompanying frontal throbbing headache disappears promptly; and the efficaciousness of stimulating foot baths and hot sitz baths in combating a headache of increased vascular tension within the skull is very well known. It is rarely necessary to administer the more powerful cardiovascular depressants in cases of this kind, the required equalizing of the circulation being obtained by hydric procedures and the administration of a few doses of the bromides. When headache is an accompaniment of a sluggish circulation, there being no deficiency in the amount of the blood and no changes of its constitution, the diffusible stimulants, caffeine, and strychnine may be relied upon to bring about its prompt relief. Cannabis indica is a drug that I frequently use with good effect in this form of headache. The method of prescribing it is in the following pills:

℞ Ext. cannabis indicæ (English), ... gr. ¼–½
Ext. gentianæ, ... q.s.
M. ft. pil. No. i.

Headaches that are dependent upon a general anæmia are oftentimes extremely resistant to treatment, and although temporary improvement usually follows tonic and stimulating treatment, the anæmia must be fought unswervingly for a long time to effect a complete cure and to stay the recurrence of the headache. These headaches are usually accompanied by a very sluggish condition of the digestive tract, to combat which I have used with very good results the following combination of tonics and laxatives in the shape of a dinner pill:

℞ Quininæ sulph.,
Ext. aloes aq., ... ää gr. xij.
Pulv. capsici,
Pulv. ipecac., ... ℥ss gr. vi.
Glycerin, ... q.s.
M. ft. pil. No. xii. S. One pill at midday.

Or, if associated with considerable vital depression, I use the following pill instead, giving at the same time some absorbable form of iron:

℞ Ext. nucis vomicæ, ... gr. ss.
Pil. rhei comp., ... gr. iij.
Pulv. capsici, ... gr. ¼
M. ft. pil. No. i. S. One pill at midday.

Naturally it is very often necessary to give at the same time, for its immediate effect, some analgesic or a combination of these with a stimulant, such as caffeine, and such a prescription as one given above, containing caffeine, phenacetin, and salol, usually meets the requirements.

Headache associated with organic diseases of the blood-vessels, such as arterial sclerosis, arteriocapillary fibrosis, as it is oftentimes called, requires very methodical treatment in addition to the maintenance of the highest possible degree of nutrition. Fortunately the number of medicines which are serviceable is very small, being covered practically by iron, nitrite of sodium, one of the iodine salts, and occasionally one of the cardiac nervines, such as strophanthus. For the acuter manifestations of such disease, such as violent throbbing in the head, buzzing in the ears, and a feeling as if the head were being dragged forcibly backward the bromides are of service, especially when exhibited in connection with the foot bath, sitz bath, or full bath to which pine-needle extract has been added. When these measures do not suffice I have frequently seen brilliant results follow the administration of a capsule containing cocaine, camphor, and powdered opium, the latter in very small quantity. The value of nitrite of sodium as an agent to dilate the arteries does not seem to me to be sufficiently recognized. It has the great advantage over the other nitrites that it maintains the dilatation of the vessels for about four

hours, whereas the action of nitroglycerin and nitrite of amyl is over in less than half an hour. The necessity of recognizing the fact that widespread fatty degeneration is the natural sequence of vascular sclerosis is very great, particularly in directing the dietary and physical hygiene of such a patient. Any considerable amount of fatty degeneration is inimical to an active degree of oxidation, and as this process is at the basis of tissue metamorphosis and food combustion, one must be on the alert not to give food in such quantities as to clog up the system with effete matters and therefore add another burden to the economy.

Headaches of Reflex Origin.—A brief review of the treatment of so-called reflex headaches must now be made. Although volumes have been written on the subject, it does not seem to me difficult to make judicious disposal of the subject in a few words. Lest it may be gathered that I underestimate the importance of disorder and disease of the sense organs in causing headache, I may say that it is my belief, based upon experience, that from one-third to one-half of all headaches are caused or influenced in their occurrence and maintenance by such conditions. This, however, does not prevent me from saying that the treatment summarized in a few words is, to remove the cause, either by operation or by the application of the indicated orthopædic appliance such as glasses, and then treat the exhausted state of the nervous system which has been induced through the strain of imperfect organs doing the work for which normal physiological apparatuses were intended. Further than this, one or two facts should be kept in mind. The first is, if the headache dependent upon defective sense organs has existed for a long time, no amount of orthopædic appliance will vanquish the headache in a considerable proportion of the cases, and furthermore, many cases of headache due to defect in the sense organs require as well general treatment that the permanent cure may be fully encompassed. After having said this, it does seem necessary to say in detail that patients who have astigmatism, hyperopia, and insufficiency should be glassed. No more does it seem necessary to say that chronic turgescence of the nasal mucous membrane, decayed teeth, and catarrh of the middle ear should be treated when found associated with a headache whose duration and character seem to point to these abnormalities as its source. Such truisms go without saying. In latter years we have heard much of the lack of muscular balance of the eyes as a cause of headache, and a considerable literature has sprung up burdened with the nomenclature of esophoria, exophoria, and hyperphoria. These conditions, a few men who claim special skill in overcoming them would have us believe are responsible for a large proportion of all headaches, as well as causative of such profound neuroses as migraine, epilepsy, and Huntington's chorea. But the consensus of opinion of those who have carefully studied the question and who, from their training and experience as well

as from their inherent mental qualities, are entitled to belief, is that such loss of muscular balance, whether due to improper implantation, innervation, or fatigue of certain eye muscles, has been enormously overestimated as a cause of headache. It is difficult for one who has investigated this matter in an unbiassed and critical state of mind to divorce himself from the thought that those who claim to cure so many scores of headaches by almost imperceptible tenotomies of the eye muscles do it for sordid and even less commendable motives.

Space precludes further consideration of the treatment of other reflex headaches and even though it did not, some of them, such as uterine headache, might be disposed of in a word, viz., put the pelvic organs in as nearly a normal state as possible, then forget the existence of the pelvic organs and centre your attention on the individual.

Habitual Headache.—I have previously spoken of a form of cephalalgia to which the name habitual headache is given, and a few words were devoted to a theory of its pathogenesis. It is diagnosticated by process of exclusion. Its treatment is oftentimes an altogether unsatisfactory experience. It is usually associated with evidences of general lowered vitality and disordered functions in other parts of the body. These, of course, must be vigorously combated. Such headache is often accompanied by leucorrhœa, and under such circumstances I not infrequently employ the following prescription:

℞ Ammonii chloridi, ... gr. lxxij.
Fl. ext. hydrastis (non-alcoholic),
Fl. ext. viburn. opul., ... āā ℥ss.
Elixir simp., ... ad ℥iij.
M. S. Teaspoonful three times a day.

If the headache is accompanied by more or less ovarian pain, I sometimes substitute the bromide of ammonium for the chloride salt. Taking it all in all, headaches of this nature are to be combated by maintaining the highest possible degree of nutrition, by the occasional use of symptom medicines that are not opiates to relieve the pain, and by mental suggestion, particularly in those who tend to develop some degree of hypochondriasis.

After thus passing in review the important causes of headache and the necessity for the most searching examination of every system of the body in order to determine its pathological relationship, it seems to me incumbent on him who writes of headache to say that despite the greatest diagnostic skill and the most herculean therapeutic efforts, the patient often remains in a frame of mind to say, paraphrasing Shakespeare:

> How weary, stale, flat, and unprofitable
> Seem to me all the physic of the world.

CHAPTER XLV.

THE TREATMENT OF DELIRIUM.

Delirium is a general disturbance or perversion of consciousness characterized by an apparent exaltation of mental processes. Close examination, however, shows this to be in reality a diminution or restriction of apperception, although association may be quickened and in consequence seemingly enriched. In detail it manifests itself by some degree of mental irritation and confusion, by more or less passing delusions and fleeting hallucinations, by disordered, senseless speech, and by motor unrest. It varies in intensity from the slightest so-called "flightiness," up to a most intense maniacal condition. The term delirium is not used synonymously with insanity, although the former, of course, presupposes an unsound mind while it lasts. I refer principally to the temporary mental disturbance occurring with bodily diseases, and not at all to the more or less highly organized, fixed, or changeable deliria of paranoia, of chronic mania, melancholia, general paresis, and the like. In other words, here the term delirium is not given the wide application which the modern French writer accords it.

To facilitate discussion, and in no way to be considered absolutely comprehensive, delirium may be classified into: primary and secondary delirium.

Primary delirium, delirium acutum, delirium grave, is not a disease *sui generis*. That is, it is not an individual affection, but a condition of varying mental disturbance, which occasionally attends different states of bodily disorder, such as collapse, intoxication, katatonia, etc. However, it is often, if not always, dependent upon, or at least associated with, demonstrable changes in the cortex of the brain.

Secondary delirium is by far the more common and the less understood. It may be subdivided into the delirium of (1) infection, (2) intoxication, (3) exhaustion, (4) irritation (peripheral and central), and (5) senility.

Etiology.—The deliria of infection are more common in the young and in the able-bodied. They occur particularly with the diseases that are dependent upon specific organisms, such as typhoid fever, pneumonia, scarlet fever, yellow fever, puerperal fever, and pyæmia, although delirium occurs with analogous diseases which have not yet been proven to be dependent upon specific organisms.

Deliria of intoxication may be subdivided into endogenous and exoge-

nous. The endogenous comprise those dependent upon septic intoxicants, and are included under the head of sapræmia, uræmia, cholæmia, diabetes, auto-intoxication, and insolation, while the exogenous include those due to alcohol, the drugs which belong to the group of mydriatics, morphine, cocaine, mineral poisons, iodoform, and the like.

The deliria of exhaustion may be subdivided into those due to inanition, to acute anæmia, such as results from hemorrhage, or from the presence in the blood of some powerful hæmolytic, such as exalgin, the plasmodium of malignant forms of malaria, wasting diseases, excessive lactation, and the like.

The deliria of central or peripheral irritation may be subdivided into those due to local injury of the brain, such as blood clot from accidental trauma or surgical operation, to meningitis, acute encephalitis, or to other central diseases. The peripheral irritation or excitation which may be associated with delirium is pain, a condition that could not be manifested without central interpretation. Delirium may also be due to, or associated with, states of central depression, such as epilepsy and hysteria.

The delirium of senility requires no subdivision, for although it occurs apparently under the auspices of different exciting factors, it in reality is caused by the morbid state of the vascular system incident to old age.

It may be remarked that no particular mention has been made of the delirium following surgical operations. This has been done advisedly because, although such delirium is not infrequent, it is due to one of three things, viz., to infection, intoxication, or exhaustion, and thus it falls under one of the captions mentioned above.

The diagnosis of delirium is very easy, and observation only is needed to determine its intensity or degree of severity. But neither its diagnosis nor the knowledge of its severity is of much service in suggesting suitable therapy. This can be decided only when the causation and the pathological associations of the delirium have been discovered.

Primary Delirium.—The delirium of the symptom complex which is now universally known as acute delirium, or delirium grave, resembles very much that which is associated with febrile diseases. It is usually accompanied by considerable rise of temperature which has no definite course, great prostration, and by rapid development of an asthenic or typhoid state. The treatment ordinarily resolves itself into fulfilling two indications, viz., securing sleep and maintaining the patient's vitality. All further treatment should be with a view to these two ends. Of the various sleep-producing measures, the cold pack and the administration of sulfonal or trional in small doses, gr. x. to xx., repeated every three hours are the most successful. When sulfonal and trional combined with these measures fail to give the desired sleep, chloral hydrate may

be given in full doses, but I never use it as the first hypnotic in this condition unless there are some special indications. In cases attended early with great restlessness and excitement, the cold pack is of signal service, both in conserving the patient's strength and in soothing him to a condition that will invite sleep. Drugs that produce hypnosis and coincident or subsequent depression, such as the bromides, opium, chloralamide, and hyoscyamine (although the latter is not usually rated as a hypnotic, but as a general motor sedative), are to be avoided if possible. Quite as important in the early stages, and much more so in the later, is the careful, judicious administration of partially or readily digested food in small quantities, and of the same temperature as the body. Sufficient emphasis cannot be laid upon the fact that in reality the chances of recovery from an attack of acute delirium stand in definite relationship to the patient's ability to retain and absorb food. Oftentimes forced feeding is necessary, and no time should be lost in resorting to the stomach tube. If the stomach will retain small quantities of nutriment, this method has advantages over rectal feeding, no matter how carefully the latter is done. As in all acute asthenic conditions, stimulants must be given early, and this is one of the diseases in which alcohol is more efficacious than other forms of stimulation. There should be no hesitancy in giving it early. A little experience soon teaches that more alcohol can be given with benefit in this disease than in any other form of intracranial mischief. This is the exception to the rule which applies to the administration of alcoholic stimulants in diseases of the brain. Naturally, the details of treatment vary with the causation of the acute delirium.

Those cases of acute delirium which are complicated with or follow other diseases require a more varied therapy directed toward the latter. Formerly it was considered of prime importance to use what may be called revulsive treatment, such as the administration of salines, the application of leeches to the scalp, and blisters behind the ears, but at the present day such measures are considered barbarous. The treatment of acute delirium may be summed up in a few words: induce sleep, maintain nutrition, fight the progressive asthenia with stimulants, counteract the profound unrest and fever with the cold pack, and carefully guard the period of convalescence. A good nurse is far more useful than an indifferent physician. The most important warning is: never give motor depressants, even though they may seem momentarily to be indicated. They are in reality therapeutic boomerangs. If it is borne in mind that in every case of delirium acutum, or delirium grave, we are dealing with acute parenchymatous encephalitis, we will rarely make the mistake of administering motor depressants to overcome motorial unrest.

Delirium of Infections.—The treatment of the deliria which I have called secondary is a very much more important subject to the general practitioner, for they are common attendants of the diseases which he

encounters. As has already been said, delirium frequently occurs with the infectious diseases, in many of the minor forms of which it is so slight and transitory that it requires no treatment. Such are the deliria occurring in young children with measles, anterior poliomyelitis, infection of the gastro-intestinal tract, and bronchopneumonia. In other diseases, and particularly in typhoid fever, pneumonia, and scarlet fever, its early occurrence is a danger signal which should prompt immediate action. Initial delirium is not very common in typhoid fever, nor in pneumonia. When it occurs in the former, it manifests itself either in a mild form, preceded or accompanied by a degree of anxiety which is soon followed by depression, and what is colloquially termed "flightiness." Such a mental state has absolutely no relationship to the temperature, and may even precede the rise of the latter. In other cases, the delirium is so severe as to constitute actual mania. These cases are likewise infrequently attended by high temperatures. They differ very materially both in their clinical manifestations and in their indications for treatment from the delirium which occurs during the third and fourth weeks of the disease. The former variety stands in direct relationship to the amount and intensity of infection, while the latter is often, but not always, an exhaustion delirium. The treatment of initial delirium of typhoid fever should be directed particularly to counteracting the effects of the infection on the nervous system. No form of therapy meets the requirements so thoroughly as the administration of one or two large doses of calomel, followed by the injection of a large amount of saline solution into the intestines, or subcutaneously beneath the mammary gland. In three recent cases of typhoid fever with initial delirium, both of the acute maniacal form, subcutaneous injections of normal salt solution into the loose cellular tissue beneath the mammary gland were followed by most gratifying results. Its presence in the blood seems to have a salutary influence in neutralizing or counteracting the injurious action of the poisonous matters on the vital centres. From four ounces to a half-pint or more may be used at one sitting. The treatment of delirium occurring in the later stages of typhoid fever does not differ materially from that of delirium due to other exhausting conditions.

In this connection a few words must be said concerning the relationship of fever to the occurrence of delirium, not alone in typhoid fever, but in other febrile diseases. There is a well-defined conviction in the minds of many physicians that the occurrence of delirium stands in definite relationship to the degree of febrility. This view is not held by the writer. Fever *per se* plays little part in the genesis of delirium, and consequently treatment directed immediately to the fever is of no avail in counteracting the delirium, except in so far as such treatment operates against the factors upon which the delirium depends.

If hyperthermia in itself can cause delirium, this symptom should

accompany hyperthermia artificially produced, and be a common symptom of diseases attended by high temperature. A little experience will, I believe, show this to be not a fact. For instance, note the colossal rise of temperature which sometimes occurs in malarial infection, in rheumatism, and occasionally even in insolation, while the mental faculties remain unimpaired. On the contrary, the mental state is quite as often the opposite of delirium in such cases. It cannot be rightfully said that because cold water, applied according to the most approved plan, in the acute febrile diseases tends to prevent delirium and to control it when it does occur, that the hydric procedure prevents or overcomes the delirium by lowering the temperature. On the contrary, the cold water hastens the elimination of the poisons in the blood which are acting harmfully upon the anterior poles of the cerebral hemisphere; it assists the blood to oxidize and consume these injurious products, and it stimulates the vital centres to renewed effort in their combat with the overwhelming agencies which are working mischief by enshrouding the sensorium. True it is that the hydric measures at the same time reduce the temperature, and their beneficial effects on these two symptoms may be coincident, but this in no way should foster the belief that the two are interdependent. On the contrary, it seems to me that fever is conditioned by a mechanism quite apart from that which causes delirium, and that to speak of febrile delirium to cover the deliria of infectious diseases is an unwarrantable assumption of the interdependence of these two symptoms.

Initial delirium in the pneumonia of the adult always means one of two things: that the subject is alcoholic or that the infection is extremely severe. Occurring in the infant it suggests that we have to do not only with a severe infection, but with an apical involvement as well. If alcoholism, or, better said, the alcoholic habit, can be left out, the chances are that the patient has a streptococcus pneumonia, and not a diplococcus or tuberculous pneumonia, as initial delirium is of much more common occurrence in the former variety. As an indication for the election of therapy, it matters not very much upon what the delirium is dependent. The treatment in every instance may be summed up in one word: stimulation, unless, indeed, the administration of a specific antitoxin be considered. The election of the stimulant, or combination of stimulants, will depend upon circumstances. If the patient be alcoholic, it will be necessary to continue giving to him the prop that served him so ill in times when he could make his own selection, and to combine it with strychnine; while in non-alcoholic cases the more diffusible stimulants and digitalis may be indicated. Here again it is necessary to speak of the choice of a hypnotic. In children, and in non-alcoholic adults, chloral in small doses is the best hypnotic, especially in the beginning of the disease; at least this has been my own experience. For the insomnia and delirium occurring later in the course of the affection, and in alco-

holics, sulfonal has served me more satisfactorily, possibly because it is always given in hot milk, which of itself is not inconsequential as a stimulant and sedative.

The deliria attending scarlet fever, and, in fact, all of the eruptive diseases, are best counteracted in the early stages by applying the ice cap and the cold pack. On account of the frequency of renal complications, and the widespread belief on the part of the laity that cold water makes the eruption "strike in," there is often great objection by parents when the cold pack is suggested; but I am sure that no other measure or combination of measures compares in efficaciousness with it in the treatment of this symptom, even though there be no hyperthermia.

The delirium attending the severe infections, such as puerperal fever and pyæmia, requires practically the same treatment as that accompanying septic pneumonia. In all of these, as in delirium acutum, sleep must be obtained at all hazards, and the patient's vitality, viz., his nutrition, must be continually aided. Here the mistake of giving motor depressants, such as the bromides, chloral, and hyoscyamine, should never be made. Moreover, it matters not how maniacal the patient may become, mechanical restraint should not be employed except as a last resort. All mechanical restraint, except that which makes captive the legs alone, impedes freedom of respiration, and thus becomes a very powerful influence in contributing to asthenic consolidation of the lungs. The restraining influence of one or more nurses, added to the sleep-producing potency of twenty grains of sulfonal or trional, given in hot milk or in some form of alcohol, is far better.

Deliria of Intoxication.—As to the endogenous varieties of this class very little need be said. The treatment consists of efforts to overcome the source of the *materies morbi*, to counteract its effect upon the central nervous system, and to secure its elimination from the system. There are two important facts which if kept in mind will greatly simplify the treatment of toxic and autotoxic deliria: First help nature to get rid of at least some of the poison in the system, then strike at the source of the intoxication. If the latter be a wound that is filled with iodoform, the removal of the latter is a very evident duty; but if the absorbent surface be the entire gastro-intestinal tract, and the injurious substance the as yet unknown toxin which produces the clinical phenomena of insolation, the task is much more difficult. But the important matter first of all is to determine with what the delirium is pathologically associated.

Of the deliria having their origin in toxic substances coming from without, delirium tremens is the most important, because it is so common, and because it is so uniformly fatal after the first or second attack. All toxic deliria are associated with more or less profound asthenia, and the first aim of treatment should be to counteract this asthenia while at the same time fulfilling a more pointed indication. In alcoholic subjects

there has almost invariably been a prolonged and outrageous indulgence in substances which destroy the metabolic functions of the economy, and before measures can be taken to counteract the influence of the poison itself upon the nervous system, the *prima via*, and the avenues leading up to it, must be carefully attended to. Therefore the first and most important therapeutic measure is the introduction of small quantities of partially digested or predigested nourishment into the patient's alimentary tract. There should be no hesitation in resorting to uncommon avenues of introducing nourishment if the patient, because of anorexia or under the influence of a delusion or hallucination, refuses food. I am so convinced that at least one-half of the patients in the early stages of delirium tremens would weather as satisfactorily the danger incident to their vice by this plan of treatment alone that I not infrequently employ it to the exclusion of all other treatment save that of some of the rapidly acting hypnotics which are not depressants.

It is extremely common for physicians, when they meet, for the first time, a patient suffering from delirium tremens, to write a prescription containing about fifteen grains of chloral, thirty of bromide, and from three to six drops of tincture of digitalis, and instruct that this be administered every four hours, and at the same time give more or less perfunctory instructions regarding the diet. At a subsequent visit, if the patient is very delirious and difficult to restrain, they give a hypodermic injection of morphine, and possibly leave orders that it be repeated, if necessary. Such a combination very frequently does more harm than good by adding to the patient's asthenia and to the depravity of the blood. I confess that I should have to be pushed very hard before indulging in the administration of a mixture recommended in one of the most recent treatises on therapeutics. The writer of the article to which I allude says that it is his custom to give drachm doses of the bromide of ammonium, fifteen grains of chloral, and one-quarter of a grain of morphine, in order to induce sleep. Such a mixture, it seems to me, has entirely too high a potentiality of dangerousness to give to any person, but particularly to one whose vitality is at a low ebb. As a matter of fact, I never use the bromide and chloral mixture, nor hyoscyamus, until four other hypnotics, sulfonal, trional, paraldehyde, and chloralamide have failed me, and a thorough trial of prolonged warm baths or a brief very hot bath. If the stimulants strychnine and digitalis are properly used, and if the indications for maintaining the patient's strength as mentioned above are fulfilled, the depressant drugs will rarely be found necessary.

I am not inclined to use alcoholic stimulants in the treatment of delirium tremens unless this condition is associated with pneumonia, as, unfortunately, it not infrequently is. When this complication is indicated, whiskey and brandy freely given will sometimes save the patient's life.

Delirium of Exhaustion.—The delirium of exhaustion is the one which is the least understood of all the deliria. It seems difficult for some to admit that it really occurs, but although it is one of the rare forms, there can be no doubt of its existence. Its association suggests the indications for treatment, and there would be no difficulty in following out the proper therapeutic plan were it not that it must be recognized by a process of exclusion. The treatment is symptomatic, and should be directed particularly to overcoming exhaustion.

Delirium of Senility.—Senile delirium is in reality a delirium of exhaustion, remotely conditioned by pathological changes in the blood-vessels, and immediately by disordered intracranial blood supply. Its chief clinical characteristics are that it is of the so-called "busy," active kind, and it almost invariably occurs at night. During the day the patient may have customary mental lucidity. In addition to the ordinary measures to maintain the patient's nutrition, special precautions should be taken to prevent harmful lowering of vitality in the early morning hours. If such a patient is taking one of the iodine salts and nitroglycerin, it is very advisable to give him a full dose on retiring, and also a liberal amount of warm peptonized milk, and to repeat this once or twice during the night, even though it be necessary to awaken him. Alcoholic stimulants are likewise of signal service in preventing delirium of this nature. Their efficaciousness seems to be increased if given in hot water or in hot milk. The value of dry heat to the extremities should not be overlooked.

Delirium of Irritation.—The deliria of central or peripheral irritation is a very large subject, and one that I cannot attempt to handle in a brief consideration of this kind. From the slight experience which I have had with cerebral injuries, either accidental or surgical, I am inclined to the opinion that surgeons are more apt to seek the cause of the delirium in infection than they are in local irritation. There may be ample reasons for this, but nevertheless delirium is so frequently a symptom of meningeal and cerebral irritation, unattended by any considerable infection or intoxication, that its occurrence should cause no astonishment. When the irritation is of a post-traumatic origin, and the delirium is continuous, this should be sufficient to warrant operative interference.

The deliria associated with states of central depression, such as epilepsy and hysteria, demand the greatest circumspection in their diagnosis and interpretation. Psychical epilepsy, that is epilepsy in which the customary motor explosion, let us say, is replaced by psychic phenomena of an uncontrollable nature, is, in proportion to the ordinary epilepsy, rather uncommon; and this perhaps accounts for the fact that it is so seldom recognized when it does occur. The psychic equivalent may assume the form of delirium, even from the very beginning, or an epilepsy starting in as an ordinary motor epilepsy may alternate in its explosions, one attack being externalized by a convulsion, another by a delirious

state. The same is true of hysteria, although hysteric delirium is rela tively more common than epileptic delirium.

Occasionally there is superadded to the typical symptoms of a sever Sydenham's chorea a profound state of unsystematized delirium. It ha been suggested by some writers that the delirium is the expression of a extensive encephalitis, it being known that in some cases of chorea whic have proved fatal vascular changes have been found which point to mild degree of parenchymatous inflammation. Personally, I am not in clined to this view. I believe that the delirium from which chore insaniens takes its descriptive adjective is analogous and comparable t the delirium which is occasionally an accompaniment of rheumatism, and that its causation is to be sought for in the profound dissociation of the component parts of the blood which occurs in both of these diseases. The treatment of chorea insaniens would be very simple were it not for the profound vascular depravity behind the chorea. This militates against the administration of a drug, exalgin, which, if given in three- to five-grain doses and repeated every two or three hours, would soon stop the delirium, at least temporarily; but as exalgin tends to liberate the hæmoglobin and thus act as a severe hæmolytic, it should never be used. The general treatment of asthenic delirium (enforced rest in bed and the administration of small doses of bromide) suffices to control the attacks in most cases. This is one of the forms of deliria in which hyoscyamus should never be given.

The treatment of epileptic delirium is practically the treatment of status epilepticus, save that the necessity for giving stimulants, which is so patent in the latter condition, is not so urgent. In reality the treatment is small doses of one of the bromine salts—let us say ten grains every hour or two, which, with mechanical restraint, usually suffices to end an attack. The treatment of hysterical delirium often baffles every resource of the physician, and then after resisting them all disappears spontaneously. The most powerful element in its treatment is complete isolation and the application of cold packs, although in many of these cases the salts of hyoscyamine given in doses up to their full physiological limit are of the greatest benefit.

General Remarks on the Treatment of Delirium.—Although therapeusis must vary in every case of delirium, and the indications in one kind may not suffice in another, nevertheless there are a few underlying principles in the treatment of all deliria. In the first place it is the opinion of the writer that sedatives are used too often and too indiscriminately. Bromides especially are frequently given offhand in large doses and over an extended period, apparently forgetful of the fact that they may, by adding to the vascular depravity which is so often at the bottom of the delirium accompanying asthenic states, intensify and prolong the duration of the symptoms for which they are given.

The general indications in the treatment of delirium are first to secure sleep; second, to overcome motor unrest; third, to support and maintain the patient's vitality by contributing to his nutrition; and fourth, to discover and remove the cause upon which the delirium is dependent.

To meet the first indication hypnotics are almost always required, although it should never for a moment be forgotten that an hour's sleep induced by measures taken to fulfil the third condition is far more salutary than three-hours' sleep obtained by the use of a hypnotic. Moreover, that in many forms of asthenic delirium, whether the asthenia be induced by infection, intoxication, exhaustion, senility, or what not, sleep is more readily induced and maintained by measures directed immediately against the asthenia than against the insomnia. In the selection of a hypnotic the one least depressant to the patient's vitality and least apt to be followed by depression should always be given preference. The motor depressants should never be used in the delirium accompanying the asthenic state, except as the very last resort. In certain forms of asthenic delirium, and especially those in which a sedative effect cannot be produced by the external application of water, drugs which are motor depressants and at the same time hypnotics may be used with the greatest benefit. Of these, the alkaloids of hyoscyamus are the most available.

The second principle is that great care should be had in the application of mechanical restraint in all forms of asthenic delirium, lest the encroachment on respiratory capacity lead to pulmonary complications which jeopardize the life of the patient. Whenever possible, manual and moral restraint are very much less dangerous. Concerning the third principle, that of maintaining the patient's vitality, sufficient has already been said. The meeting of the fourth indication, viz., the discovery and removal of the cause of the delirium, is after all the most essential procedure in the treatment of this symptom. To do this the pathological association must be determined, and then our ammunition levelled directly against it, while simultaneously the three first enumerated principles are guiding us in symptomatic therapy.

CHAPTER XLVI.

THE TREATMENT OF VERTIGO.

Vertigo is the term applied to a disturbance of the sense of equilibrium and of position in space relative to objects of the environment. The common synonyms are giddiness and dizziness, the latter term being less appropriate than the former. Vertigo is often referred to as subjective and objective, according to whether the surrounding objects seem to move and to be unstable, or the patient himself seems to be the seat of the movement. In its less severe manifestations vertigo is a common disorder, yet compared with headache it is relatively uncommon. Like headache it is always a symptom, although one form of vertigo, which is now universally known by the name of the physician who first described it, Ménière's disease, is usually considered a disease *sui generis*. But even here vertigo is only one of the symptoms associated with the lesion in and around the semicircular canals. It matters not the condition with which vertigo is associated, if the symptoms are sufficiently severe, it is usually preceded or accompanied by nausea, vomiting, vasomotor phenomena, and a sense of depression or ill-being.

Vertigo is really a subjective disturbance of consciousness, a psychical occurrence in which a feeling or sensation of instability is the most prominent feature. Formerly it was taught that vertigo was conditioned by disturbance of the intracranial circulation, and in this way were interpreted the aural vertigos, ocular vertigos, toxic vertigos, and the like. This explanation being purely hypothetical was unable to withstand the tests of experimental physiology. The latter has shown that irritation of the cerebellum or its peduncles, of the semicircular canals, and of what appears to be the auditory nerve—but which is in reality a nerve travelling with the acoustic nerve and destined especially for the semicircular canals, known as the nerve of Cyon—produces a variable but always intense degree of vertigo, even though no changes in the vascular supply accompany them. Recently, Mendel has contended that the proximate cause of all vertigo, apart from that arising as a disturbance of the organism of equilibrium, is a functional disturbance of the ganglion cells that form the nuclei which preside over the movements of the ocular muscles, and is conditioned through the circulation. The fact that the fine terminal branches of the posterior cerebral artery which supplies the nuclei of the ocular muscles do not anastomose has led Men-

del to the belief that comparatively slight disturbance of vascular tonus in these vessels may cause vertigo.

For purposes of convenience vertigo may be classified as:

1. A symptom of disease or disturbance of the semicircular canals, the nerves of Cyon, or of the cerebellum; in short, disturbance, whether organic or non-organic, of the apparatus of equilibrium.

2. Pseudo-Ménière's disease; disease of the external and middle ear, aural polypi; disease of the Eustachian tube.

3. A symptom of organic brain disease; brain tumor; brain syphilis; multiple sclerosis.

4. A symptom of inco-ordination of sensory impressions by the brain, received particularly through the sense of sight.

5. A symptom of disordered blood supply to the brain, be it dependent upon functional perversion or organic disease of the vessels.

6. An accompaniment and symptom of one of the neuroses, such as epilepsy, neurasthenia, and hysteria.

7. A symptom of the dyscrasiæ or of the intoxications and infections leading to them. Gerlier's disease, anæmia, etc.

8. Vertigo which may be described as reflex, in order to explain the correlation between the occurrence of vertigo and disorder of some distant organ. Stomachic vertigo, laryngeal vertigo, etc.

Ménière's Disease.—By far the most important of all the vertigos is that known as Ménière's disease, or aural vertigo. This disease was first described in 1861 by Ménière, who reported the case of a young girl who was suddenly taken with violent vertigo, vomiting, and deafness. She died within a short time, and post-mortem examination showed that the semicircular canals were partially filled with a red, plastic exudate. It was inferred from this experience that lesion of the semicircular canals had caused the disease, but it has since then been abundantly proven that similar manifestations may occur without such pathological process. There seems to be incontrovertible evidence that the symptom complex of Ménière's disease may be caused by different chronic pathological processes of the middle and internal ear; and it is unquestionable that encroachment upon the nerves of Cyon in its course outside of the semicircular canals can produce like symptoms. These varieties of vertigo are usually known as pseudo-Ménière's disease, and although it is oftentimes difficult to distinguish them, it is unnecessary to do so. It has been shown, moreover, that aural vertigo does not always come on in the sudden, unheralded way first described by Ménière, although it does in perhaps more than one-half of all the cases. When the attack comes on in apoplectic fashion, the patient is taken suddenly with subjective noises and rumbling, and buzzings in the head and ears. These are immediately followed by a sensation as if the surrounding objects or the patient himself were turning around on a vertical or a horizontal axis.

This is accompanied by disturbance of co-ordination, which may b great that the patient falls violently to the ground, and by a feelin mental and physical distress, nausea, and vomiting. At the heigh the attack there is some encroachment upon or limitation of consci ness. Nearly always, however, this is only passing. These phenom may last for only a few minutes, or they may continue for several ho and then gradually grow milder and disappear, leaving a sensatio weakness and exhaustion and a diminution of hearing in one or both e which is persistent.

The attacks occur with no regularity. In some cases a few d while in others a number of months intervene. In the interval the tient feels pretty well ordinarily, but there is always a tendency to ziness, especially on coughing, sneezing, and making quick moveme such as getting up, and turning around suddenly. After the first att examination of the hearing shows lessened aerial conduction and m or less loss of bone conduction. Eventually hearing is entirely l and then the attacks usually cease, for this is an indication of compl destruction of the semicircular canals. The outcome of Ménière's dise is not usually very satisfactory. In the apoplectic cases the prognosi rather grave. In the milder cases, those that come on more gradual life does not seem to be shortened by the occurrence of the vertigo.

Treatment of Ménière's Disease.—As in every other symptom c plex, the treatment of Ménière's disease consists first in searching and removing the cause, and then adopting treatment directed tow relief of the symptoms and prevention of their repetition. All that known of the causation of the disease is that it occurs with leukæm neurasthenia, and occasionally with tabes and in those who give hist of syphilitic infection. The medicinal treatment of Ménière's disease of greatest importance. During the immediate attack the patient sho be kept in bed. Some relief is often obtained by the application of L ter's coil, or cold application to the head when the former is not to had. Counter-irritations to the back of the neck and over the mastoi as well as blood-letting, do not seem to give any benefit. The admi istration of a rapidly acting cathartic ameliorates the symptoms if th continue for any length of time. The drug which is superior to others is quinine. It was originally suggested in this condition by Cha cot, who was led to use it by a consideration of the intracranial su jective phenomena which it produces when taken in physiological dos It should be given in three-grain doses four times daily, and kept for a period of from six to ten days. Then it should be stopped f about a week, when it is renewed again, and kept up an equal numb of days. This plan of giving it in alternate intervals should be conti ued for a number of weeks. When it is first given it almost invariab causes some exacerbation of the symptoms, but after being kept up f

a few days its efficacy becomes very evident. It rarely fails to lengthen the intervals between the attacks, and finally either entirely to relieve the patient or so greatly to ameliorate his infirmity that it becomes bearable. Nevertheless, a number of cases prove rebellious to this plan of treatment. The truth of this is sufficiently indicated by the fact that other drugs having a physiological action similar to quinine in many respects have been recommended. Of these, salol and salicylate of sodium are the most important, the former given in from five- to ten-grain doses, three times a day, and the latter in double that quantity. They are warmly recommended by some writers, but in my experience they are not so satisfactory as quinine. In cases in which the throbbing and sousing noises in the ears are extremely severe, the administration of ergot and nitrite of amyl is sometimes followed by excellent results. On the other hand, when the peripheral circulation is feeble and there are evidences of profound sympathetic nerve depression, tincture of nux vomica given in five-drop doses every hour will be found very serviceable. The bromine salts are given very extensively in this and other varieties of vertigo, but I have had no benefit from them that warrants me in recommending their administration in Ménière's disease.

The general treatment of Ménière's disease is practically the general treatment of neurasthenia. Patients who can afford a change of surroundings should be advised to sojourn for a few weeks in an altitude of some two to three thousand feet, and the bodily tone should be improved by means of suitable appetizers, food, and medicinal tissue builders, and also by the use of tonic hydriatic measures and exercise in the open air. The necessity for giving up stimulants and narcotics and avoiding anything that causes disturbance of intracranial circulation, and the adoption of a quiet life, for a time at least, is very evident.

Pseudo-Ménière's Disease.—The fact that a similar symptom complex sometimes develops with acute otitis, sclerotic inflammation of the middle ear, relaxation of the membrani tympani, and disease of the ossicles has already been mentioned. This is properly known as a pseudo-Ménière symptom complex. Cases have been recorded in which the removal of cerumen and foreign bodies from the external auditory canal has relieved auditory vertigo. The treatment of vertigo associated with middle-ear disease depends entirely upon the nature of the lesion. If it is due to relaxation of the membrani tympani, desirable results often follow perforation of the drum by means of the electric cautery. The contraction which accompanies scar formation is sufficient to take up the relaxation. Tenotomy of the tensor tympani has also been suggested for the relief of this condition, but it is not looked upon with much favor by aurists. When the symptoms of aural vertigo occur in a patient who has evidences of encroachment upon the Eustachian tube, it is necessary to explore the nasopharynx and remove any vegetations from the posterior nasal fossa or

counteract any disease that may exist. Many cases of middle-ear disease with accompanying Ménière symptom complex are relieved by catheterization and the careful use of Politzer's air douche. It is of great importance that too great aerial compression should be avoided in Politzerization, otherwise the trauma which it produces will result injuriously. Purulent processes in the middle ear must be evacuated by puncture of the drum membane. Adhesions, sclerosis, and induration of the tympanic cavity require medical treatment directed against the conditions which cause these lesions, be they syphilitic, gouty, rheumatic, or post-inflammatory. A great number of measures have been proposed to overcome the sclerosis and thickening of the tympanic cavity, such as massage of the tympanum, the use of the galvanic current, the application of small blisters or *pointes de feu* over the mastoid process. It is possible that in cases in which these measures are immediately indicated benefit sometimes follows their careful application. It would be extremely hazardous to apply them, however, save under the immediate direction of an experienced aurist. If one may base an opinion on the writings of the latter, it is safe to say that as a rule these measures are not looked upon with much favor by otologists.

In vertigo dependent upon sclerosis of the middle ear and post-inflammatory thickening of the tympanum with adhesion of the ossicles, I have seen the administration of bromide and iodide of potassium together cause very considerable improvement. Many writers recommend the use of the galvanic current, the positive pole on the tragus and the negative pole on the chest or back, letting as strong a current flow as the patient can stand, then gradually diminishing it. This procedure, as well as galvanization of the sympathetic, is mentioned only to be condemned. The application of electricity often adds materially to the intensity of the vertigo, and never, I believe, has any influence in shaping its recovery. The measure that is of most service in the treatment of labyrinthine vertigo, whether it be due to hemorrhage, inflammatory exudate, or encroachment upon the nerve of Cyon, is the subcutaneous injection of hydrochlorate of pilocarpine; from two to ten drops of a two-per-cent solution should be given three or four times a day, or until it produces sweating and salivation. The medicament should not be used for more than a few days, unless evident benefit follows the first ten or fifteen injections.

Vertigo of Organic Brain Disease.—Vertigo is one of the most constant symptoms of organic brain disease, particularly of the slowly developing varieties such as tumor, disseminated sclerosis, and brain syphilis, meningeal, vascular, or of the brain substance. It is a very important symptom of brain tumor. It occurs in from one-third to one-half of all the cases of tumor of the frontal region, while it almost always accompanies cerebellar tumor, particularly if the worm in its basal segments is

involved. When its occurrence is associated with irritative or paralytic motor phenomena the central convolutions are probably the seat of the neoplasm. The only therapeutic conclusion to be drawn from this is that its occurrence and association may be of some localizing value and thus point for or against operation.

Vertigo, a symptomatic accompaniment of brain syphilis, is not an easy matter to interpret satisfactorily. It is often one of the earliest symptoms. It is usually associated with other symptoms whose existence bespeaks the implication of the blood-vessels, such as fleeting attacks of syncope, transient obscuration of vision, noises in the head and ears, feelings of exhaustion, depression of spirits, and emotionality. Rarely is it associated with convulsive or paralytic phenomena. Its diagnosis is to be made from its history and associated symptoms. Its existence calls for the most vigorous antisyphilitic treatment, rest, and mild vascular stimulation.

The vertigo that accompanies cerebral disseminated sclerosis does not call for particular consideration. It occurs in about forty per cent of the cases. Vertigo of hydrocephalus may be relieved by the use of lumbar puncture, or other surgical procedure applicable to this condition.

Vertigo accompanies both anæmia and hyperæmia of the brain, whether these conditions be dependent upon functional disorder or organic disease of the vessels. For instance, it may occur with idiopathic anæmia, with secondary anæmia, and with insufficiency of the aortic valve. On the other hand, it is in many cases an extremely early and important symptom of arterial degeneration, especially of the sclerotic variety. It is particularly liable to occur when the arterial sclerosis develops rapidly, as, for instance, after infection and from the activity of continual intoxication. In the beginning it may be the expression of increased arterial pressure without material change in the brain. Very soon, however, it is immediately conditioned by deficient blood supply, and is associated with beginning changes in the parenchyma of the brain. These are indicated by the fact that in advanced cases vertigo of arteriosclerosis is accompanied by general mental weakness, inability to concentrate thought, forgetfulness, irritability, and in the graver forms by epileptiform and syncopal attacks. Vertigo in arteriosclerosis is oftentimes the harbinger of apoplexy, rupture, embolic process, and softening. Vertigo that results from congestion of the cerebral blood-vessels, be it from excessive cardial stimulation, an attack of asthma, or from prolonged mental work, is combated by cerebral and cardiac sedatives, such as bromide of sodium, given alone or in connection with fluid extract of ergot; by rest, by the application of sinapisms to the extremities, and by stimulating foot baths. On the other hand, if the anæmia is an expression of aortic insufficiency, the indications are: the adoption of measures which will facilitate ventricular compensation; the utilization of cold applications over

the cardiac region; absolute rest; minute doses of digitalis; and the persistent administration of an absorbable preparation of iron, which is very evident. It is unnecessary likewise to speak of giving iron, arsenic, and the vegetable bitters to combat the vertigo of any form of general anæmia, as such treatment is plainly indicated to overcome the condition on which the vertigo is dependent. As a temporizing measure in such a condition, a pill composed of gr. $\frac{1}{10}$ of extract of opium and phosphide of zinc will be found of great service. The important measures in combating arterial sclerosis are: suitable dietary, methodical, uneventful régime; plentiful supply of fresh air; the prolonged administration of small doses of (six to ten grains) of iodide of potassium or of sodium, combined with minute doses of digitalis (gr. $\frac{1}{3}$ to $\frac{1}{2}$); small doses of iron to resist tendency to fatty degeneration; and the use of temporary measures to dilate the smaller blood-vessels, and thus diminish vascular tension and promote lymph circulation. For this purpose one of the nitrite preparations is used, preferably the nitrite of sodium, given in one-grain doses every four hours. Its administration is kept up for a few days only and then stopped, to be resumed whenever symptomatic indications arise. If a cardiac stimulant is indicated in connection with the nitroglycerin or nitrite of sodium, camphor, given in a capsule, with minute doses of opium or valerianate of menthol, will be found more trustworthy than any other measures.

℞ Menthol. valerianat.,
Camphoræ, ... āā ʒ ss.
Pulv. opii, ... gr. ½
Ol. olivæ, ... ʒ i.
M. ft. caps. No. xii. S. One capsule twice a day.

The writer's experience with alcoholic stimulants in arterial sclerosis does not tally with that of many fellow-practitioners who have written on the subject. The absolute interdiction of mild stimulants, such as small quantities of whiskey and hot water, and a very light wine with meals, is, I believe, a mistake in treating patients with arteriocapillary fibrosis, at least in the elderly. The perniciousness of nicotine is immeasurably greater in these cases than that of alcohol.

It is well known that gout is one of the most potent factors in causing arterial degeneration, and it is not surprising, therefore, that vertigo accompanying this diathesis should be looked upon as a manifestation of the graver disorder. Nevertheless, in a large proportion of the cases of vertigo attending an acute attack of gout, and in a fair proportion of those accompanying gouty manifestations, vertigo is dependent rather upon the change in the blood than upon changes in the vessels. This variety of vertigo is to be interpreted by other more certain manifestations of the gouty state and by the absence of degeneration that can be

recognized in the vessels. Its treatment rarely requires any other medication than that directed toward the condition of which it is a symptom. Regulation of the diet, the administration of alkalies, the adoption of sufficient exercise to facilitate metabolism, and the exhibition of colchicum in some form usually suffices to keep the gouty manifestations in check, though they may not cure the diathesis. If there are evidences of arterial sclerosis in a patient who has gouty vertigo, it is necessary to adopt the form of treatment already spoken of to counteract this disease. Vertigo is relatively an extremely uncommon rheumatic manifestation, although sometimes it occurs when there are evidences of accumulation of uric acid in the blood. Some writers have endeavored to show that uric acid is one of the commonest causes of vertigo, but they bring forward very unsatisfactory proof in substantiation.

Vertigo of the Neuroses.—Vertigo sometimes occurs as an aura of epilepsy, and it often occurs after an epileptic convulsion, with the fatigue, mental confusion, and prostration of this period. It is an open question whether or not vertigo may take the place of an epileptic attack, that is, be the epileptic equivalent. There is a form of vertigo which comes on suddenly, independently of any apparent source of excitation, and of more or less irregular occurrence, apparently conditioned somewhat by fatigue and exhaustion, to which the name epileptoid vertigo is given. It is more responsive to anti-epileptic treatment than to any other measure. This treatment consists in the administration of bromides, care of the digestive tract and the emunctories, and the general condition of health. Although apparently it does not tend to develop into the motor form of epilepsy, it may nevertheless be legitimately looked upon as of similar pathogenesis. The treatment of pre-epileptic vertigo is in reality the treatment of epilepsy. Very rarely can any medication be undertaken between the time of the vertiginous manifestations and the convulsive state. In all such cases it is well to give, along with the bromides, a mixture of fluid extract of belladonna and fluid extract of adonis vernalis. Post-epileptic vertigo should be made more bearable and less severe by insisting upon absolute quiet, and by giving a rapidly diffusible stimulant, such as a cup of strong coffee, caffeine, or valerianate of ammonia.

The most essential factor in the treatment of vertigo accompanying neurasthenia, hysteria, exophthalmic goitre, and enteroptosis, is the recognition of the condition on which it is dependent. The measures that must be adopted for its relief may perhaps include all of those recommended in the treatment of any of these conditions. Vertigo is one of the commonest complaints of neurasthenic patients, yet very rarely is it necessary to use remedies directed immediately to its relief. The general tonic, restorative, educational treatment of neurasthenia encompasses its disappearance. The same may be said of the treatment of vertigo accom-

panying Graves' disease. Nevertheless, it should be kept in mind t occasionally the vertiginous symptoms of exophthalmic goitre are co tioned immediately by insufficiency of one or more of the eye musc Vertigo accompanying Glenard's disease requires no other treatment t that directed for the relief of the enteroptosis. Such measures may b simple as the wearing of an abdominal bandage, or so radical as the o ation of nephrorrhaphy.

Ocular Vertigo.—The commonest cause of vertigo is some disturba of the mechanism of vision. The pathogenesis of this symptom has b already referred to. Whether or not it be immediately conditioned b perversion of circulation in the nuclei of the ocular muscles does not h concern us. It may be contended, however, without fear of contradicti that the immediate factor in its occurrence is the reception by the br of disparate and unaccustomed sensory impressions coming in through t eyes. It does not by any means follow that such impressions are normal. For instance, severe attacks of vertigo have been known to f low the operation of tenotomy for strabismus. In such a case the pers has become so accustomed to interpreting monocular images that the ception of double images puzzles his visual sensorium, and the result vertigo. Vertigo is the commonest accompaniment of palsy of any of t ocular muscles, in which case it is due to a similar faulty projection of t visual field. Such vertigo is exactly similar to that which may be pr duced in a normal individual by looking through a prism, base upwar for a few minutes. Ocular vertigo is frequently associated with dipl pia, and if this symptom is mentioned by the patient it promptly lea to the correct interpretation. Paresis of the superior rectus, perhaps t commonest palsy of the eye muscles, often induces vertigo without dipl pia. This variety of vertigo is frequently extremely puzzling, and ofte times receives much misdirected treatment. The treatment of ocul vertigo may be summed up in a line: it consists in remedying the shor comings of the ocular muscles in so far as it is possible, either by th use of glasses or by tenotomy of the eye muscles. As the ocular palsy i often an expression of severe bodily disease, such as syphilis, it is nece sary to inquire carefully into the existence of such conditions, and t combat them vigorously when found.

Toxic Vertigos.—The occurrence of vertigo from poisoning by tobacc alcohol, lead, quinine, and salicylic acid, and after the infectious dis eases, is not an easy matter to interpret. In addition to the enervatin effect which these substances have upon the peripheral neuromuscular ap paratus of the body, and their injuriousness to the nerve cells, they ac destructively upon the blood, to impair its constitution and composition and upon the mechanism of its circulation. All these factors are con cerned probably in the causation of vertigo. This is seen by the accom panying phenomena such as a feeling of uncertainty, sinking sensation

nausea, and vasomotor and secretory manifestations. Therefore the treatment of vertigo arising from the use, abuse, or occurrence of these intoxications and diseases consists not alone in interdicting or combating them, but in adopting measures to counteract the neuromuscular impairment and to recover the loss from hæmolytic destruction. The occurrence of vertigo after the infectious diseases, such as measles, scarlet fever, and typhoid fever, should always prompt us to search most diligently for purulent infection of the middle ear, and of the nasopharyngeal cavities, and when found, to adopt measures looking to their immediate relief.

Gerlier's Disease.—Gerlier's disease, vertigo with ptosis, or paralyzing vertigo, is the name given to a rare disease characterized by vertigo, peculiar paralytic phenomena, and pain which occurs in men and in some of the lower animals (the cat). It is caused by living in close contact with stabled cows, especially in hot weather, in the region around Lake Geneva. Cases of the disease (for in all probability it is a general infection arising from the activity of a poison generated in stables) have recently been reported from Japan. The disease is probably a cerebral motor neurosis due to a fungus. Although vertigo is a prominent symptom, there are in reality more important ones. These are more or less transient ocular palsies which cause diplopia; ptosis; transient paresis of the muscles of the back of the neck associated with great pain in this region and in the lumbar region; and a peculiar inability to open the mouth and to close the hands, described as pseudo-trismus. The gait is weak and staggering, and during an attack of vertigo the patient may fall heavily. The vertigo is undoubtedly of the ocular variety. Gerlier distinguishes three types: (1) The sleeper's type in which ptosis is the prominent symptom; (2) The devout type in which in addition to the ptosis the head drops on the chest; and (3) The drunk and blind type in which in addition to the above symptom there is paresis of the lower extremities and consequent staggering, waddling gait. The symptoms occur in attacks, each lasting one or two minutes, and followed by an interval of variable duration during which time the patient feels used up, tremulous, and emotional. An exacerbation can be provoked with certainty by using the eyes. The real treatment is prophylaxis. The disease lasts from one to a few months, and is not fatal. Its disappearance is hastened by giving medicines that facilitate elimination, and at the same time tonic, restorative, physical or medicinal treatment.

Reflex Vertigos.—Formerly the reflex origin of functional nervous disease played a much more important rôle than it does nowadays. Vertigo was one of the conditions or symptoms that was thought to be very frequently of reflex origin, that is, caused by factors operating from some distant organ connected only very indirectly with the parts or tissues in which the symptoms were manifest. Vertigo of a mild and transitory character is sometimes associated with gastric disturbance, such as chronic

gastric catarrh, and myasthenia gastrica; with constipation; with sluggish state of the digestive system commonly known as biliousness; with disorder of the pelvic organs in women. Such vertigo is much common, however, than is usually supposed. It is entirely possible to plain its occurrence on the ground of the absorption into the system of eterious matter from the alimentary canal on the one hand, or the e vating influence of long disturbed nutrition on the neuromuscular appar on the other. And in the use of the word reflex we should have no o formula of pathogenesis in mind. The elements that condition its oc rence are those that cause neurasthenic and hypochondriacal symptom often associated. The treatment of such vertigo is in a word the tr ment of any morbid condition with which it is associated, whether it dilatation of the stomach, achylia gastrica, constipation, cholelithiasis, intestinal parasites. Some rhinologists claim that many cases of vert are relieved by the removal of nasal polypoids, the destruction of the h pertrophic mucous membrane that results from chronic nasal catarrh, a by the treatment of turgescent turbinates. The general practition passing in review all the deviations from normal which the patient p sents, will not fail to detect these if present, and institute measures f their relief.

A remarkable symptom complex described by Charcot as laryng vertigo must be mentioned, although it is very unlikely that it can considered reflex vertigo. Its occurrence is preceded by a sensation dryness and irritation in the throat accompanied by an irritating coug and soon followed by abrupt loss of consciousness, with or without epile tiform twitchings. The attacks may occur as often as twenty in a da In reality this symptom complex is a symptom of cortical or spinal irrit tion or explosion, and has very little relationship to vertigo as it is gene ally understood.

CHAPTER XLVII.

THE TREATMENT OF CONVULSIONS.

A CONVULSION is always a symptom. Therefore, on casual consideration it may seem unnecessary to refer to the subject apart from the conditions of which it is a symptom. But the same may be said of headache, of delirium, neuralgia, hemiplegia, and other symptoms which it has been thought advisable to consider individually. Often the physician is summoned to treat what are apparently convulsions, and it is well, therefore, to have in mind not only the conditions which they indicate, but the measures that are of use in combating them, whatever be their cause.

Convulsions are an expression of irritation of the motor areas of the cortex, or of the convulsive areas in the brain, ganglia, pons, and oblongata. This irritation may be direct and mechanical due to a clot of blood, or a spiculum of bone; direct and chemical as from the circulation of peccant matter in the blood; it may be indirect as from the transmission of sensory irritation from an adjacent or distant part of the body, the alimentary tract, the nasal mucous membrane, the sexual organs; or it may be a manifestation of idiopathic epilepsy. Under the first may be included new growths of every kind, either of the brain substance or of the surrounding tissue which causes encroachment upon the brain, and inflammatory, hemorrhagic, and traumatic products. Under the second are included febrile states of the blood, such as pneumonia, scarlatina, and measles; irritant matters circulating in the blood, endogenous or exogenous, which include the different poisons arising within the system from perverted glandular action and incompetency of the emunctories, such as uræmia and auto-intoxication in diabetes; and those coming from without, such as the infections and intoxications. Under the third heading are included all the so-called reflex convulsions which are not uncommon in children, although extremely so in adults. The starting-point of the reflex irritation is commonly some part of the alimentary canal.

It will be readily seen that a detailed discussion of the causes of convulsion would require consideration of many diseases. I shall therefore limit myself chiefly to a discussion of convulsions in children. The name eclampsia is used to indicate convulsive attacks which occur during the first year of life, and are not dependent upon organic disease of the nervous system. Convulsions are much more apt to occur from slight causes in young children than in adults. It should not be forgotten

that they are frequently manifestations of genuine epilepsy, and that even though parents make light of them, they deserve the most careful consideration. Close inquiry into the history of epileptic patients shows that about twelve per cent give a history of spasms or convulsions in infancy, which were attributed to teething, indigestion, worms, and the like, while in reality they are the original manifestations of the epileptic neurosis.

The liability to convulsions, of whatever origin, is greater during the first year. After this time it diminishes rapidly, and eclampsia in children is rare after the first dentition. The most powerful predisposing cause of infantile eclampsia is the perversion of nutrition known as rachitis, and the improper feeding which contributes to it. The influence of dentition in causing convulsions in children has been variously estimated, the trend of opinion at the present time being to attach little importance to this physiological act. Nevertheless, it would seem to be beyond question that in some instances it is the exciting cause. The convulsions that occur with gastro-intestinal disorders are either reflex or autotoxic, probably more the former than the latter. Intestinal parasites constitute the most uncommon cause of infantile eclampsia.

The same general principles apply to the treatment of convulsions as to that of all other symptoms which are so profound as to require treatment directed to their relief individually. In other words, it is not sufficient to treat the symptom itself; the cause must be sought for and removed, or its activity combated. When a physician is called to a child with convulsions, the urgency of the symptoms often does not permit of search for the cause. Both on account of the parents' peace of mind and the patient's welfare the convulsion should be terminated at once. Although there are many domestic measures which are of some service in lessening the intensity of the convulsions and shortening them, as a rule these will have been used before the arrival of the physician. If they have not been, and the convulsive seizure is a severe one, it is a loss of valuable time to put the patient in warm water, to apply stimulating pediluvia, etc., although these measures, together with the removal of the cause of the convulsions, may be all that is necessary in mild attacks. The fact that the mortality of infantile eclampsia is upward of ten per cent shows how necessary it is to adopt adequate measures to check the convulsions. For this purpose no hesitancy should be had in using inhalations of chloroform or of nitrite of amyl, or a mixture of equal parts of these drugs, naturally with great precaution, until the tonic or tonico-clonic spasm begins to subside. There is some slight danger in this procedure, and if the patient should die while inhaling the chloroform, it is almost certain that blame would be attached to the physician; but in view of the mortality rate already spoken of, and the reasons against giving the most potent anti-convulsant, morphine, to young children, this procedure is unconditionally recommended for the severer cases. Indications

of the recurrence of the spasm should be met by repeating the inhalations. It is hardly ever necessary to carry the patient into even a slight state of narcosis, except in those instances in which the convulsion is an expression of active organic process, such as hemorrhagic encephalitis. If the patient is put in a warm wet pack, with ice to the head after the first convulsion, this will very often prevent a second attack, and so will immersion for a long time in a lukewarm bath.

After the severity of the convulsions has been combated, or after the attack has ceased, at least temporarily, then is the time to find out what the convulsion signifies, and to apply measures looking directly to the removal of the cause. At this time a number of anticonvulsives which are not sufficient to cope with the spasm itself may be used. The best of these are the bromides and chloral, both of which may be given by enema. In adults, opium admirably and adequately fulfils the indications. The patient should be kept absolutely quiet in bed, and given the simplest diet, while cold by means of an ice-bag is applied to the head. Drugs that have repute as antispasmodics or anticonvulsives, such as valerian, asafœtida, and belladonna may be given, but it is difficult to estimate their real service, except in hysterical cases.

When the convulsion is the forerunner or an accompaniment of scarlet fever, measles, pneumonia, malaria, or other infectious disease, the measures that have already been mentioned for combating the attack should be utilized; and afterward an attempt made to mitigate the severity of the disease. In such cases it is generally the high temperature that provokes the convulsion; and it should be borne in mind that hyperthermia, it matters not the disease with which it occurs, is most safely and quickly combated by the use of cold water.

Treatment of the Causes.—In many cases it will be possible to remove or combat the cause at once, as, for instance, when the attack is due to indigestible or irritating products in the stomach and bowels, to cholera infantum, dysentery, swollen gums associated with eruption of the teeth, and organic poisons in the blood, such as urea and glucose. But in other instances in which the cause is of an organic nature, and the convulsions are an expression of some mechanical irritation, such as meningeal hemorrhage, products of inflammation, new growths of the central nervous system or its coverings, and traumatic conditions, it will be impossible to remove the cause, at least at the time, although measures may be at once taken to alleviate it. The appropriate causal treatment varies with the different diseases or conditions upon which the convulsions are dependent. If they are an expression of intracranial inflammation, the treatment should be ice-bags to the head, and the application or administration of derivatives, such as diuretics, diaphoretics, and cathartics, stimulating pediluvia, and the abstraction of blood. If the convulsions are due to the circulation of injurious substances in the blood, measures must be taken

to secure their elimination by the different emunctories, while drugs th combat the activity of the poisons are given. The causal therapy for co vulsions which arise from irritation of the motorial areas by the produc of accidents or new growths needs only mere mention. It is chiefly su gical. The treatment of hysterical and epileptic convulsions is the sa as that indicated for these neuroses, plus the treatment of an atta which has already been considered.

Convulsions are often brought about or contributed to, especially children, by hydræmia and other impoverished conditions of the bloo such as occur with rachitis and after acute infectious diseases. They m occur without any other cause than loss of blood. When any of the conditions can be found it should receive particular treatment. In r chitic children phosphorus, cod-liver oil, arsenic, and quinine may l given for their constitutional effects, and at the same time small doses bromides or valerian for their transient symptomatic effect. Cases i which there is profound hydræmia should be treated by subcutaneous in jection of normal saline solution, or by intravenous transfusion.

The condition of the buccal cavity and the gastro-intestinal cana should be investigated with great care in every case of eclampsia infan tum. Swollen, inflamed gums should not be treated by cutting, nor by giving the patient something to bite on; such measures add to peripher irritation which is already excessive to a pathological degree. They should be treated by antiphlogistic application, such as cold to the outside of the face and dilute solution of aconite and iodine locally. If there i reason to suspect the presence of indigestible substances in the stomach a brisk emetic as ipecacuanha should be given and then a cathartic, o thorough intestinal irrigation should be made. The latter is sufficient when constipation alone seems to be the cause of the attack. A suspicion of intestinal worms justifies the administration of any of the reliable anthelmintics, such as santonin and the salines, after which the stools should be scrutinized for small worms and sections of tape-worms, and i these are found, remedies adapted to their expulsion given. Careful examination of the urine and of the blood is of the greatest service, and any deviations from normal which such examinations reveal should be rigorously combated.

When convulsions are apparently excited by hyperthermia, the most gratifying results follow putting the patient in a bath of from 85° to 75° F., and letting him remain there from fifteen to thirty minutes. If this is not feasible, the same object can be gained by cold-water ablutions, or by the application of the cold pack and an ice-bag to the head. If an adherent prepuce or any other source of peripheral irritation can be discovered, it should be corrected as soon as possible.

Laryngismus Stridulus.

Laryngismus stridulus, or cerebral croup, as it is sometimes called, is a local form of convulsion which occurs almost exclusively in children who are profoundly rachitic and who present such manifestations of that nutritional disturbance as craniotabes, epiphyseal enlargements, and rachitic rosary. The spasm comes on abruptly, and the symptoms soon become so alarming that often it is necessary to use heroic measures, such as tracheotomy, to spare the child's life. In the ordinary case it is sufficient to lift the child from bed, throw the head back so that air may enter the respiratory passages with facility as soon as the spasm relaxes, pull the tongue forward, throw cold water against the body, or subject the skin to smart flagellations in order to stimulate the inspiratory centre to activity. When this occurs the prolonged inspiration is accompanied by a whoop and the spasm relaxes. If it is possible to make the patient inhale at all, a few drops of chloroform or of nitrite of amyl will quickly end the spasm, and whenever they are at hand and can be used this is the treatment to follow. In some instances wrapping a compress wrung out of hot water around the throat, and then throwing cold water against the surface of the body, is quickly efficacious.

If the spasm is persistent, and the child's life is despaired of, there should be no hesitation in opening the trachea to permit the ingress of air. In cases in which the ordinary measures do not suffice to relieve the spasm promptly, it is advisable to give a small dose of morphine hypodermically. This is usually soon followed by relaxation of the spasm.

Attacks of laryngismus stridulus are usually over before the physician reaches the patient. It then devolves upon him to prevent recurrence of the symptoms. This can be done by giving bromides, valerian, asafœtida, etc., for their symptomatic effects, and substances that combat the depravity of nutrition which allows the symptoms to occur. The condition of the uvula should be investigated, for in some instances hypertrophic or inflammatory enlargement of it is the cause of the spasm. When such is the case, the uvula should be shortened by operation, if treatment of the causes is not sufficient to overcome the enlargment.

Spasmus Nutans.

Head nodding and rotatory movements of the head are not very uncommon in rachitic infants, especially those who have received some injury, such as a blow or fall on the head. The condition is often associated with nystagmus and occasionally there is a history of convulsions. By some the disease is looked upon as a form of traumatic

neurosis, but personally this view is extremely antipathic, as I am of the opinion that psychical trauma is a *sine qua non* of every variety of traumatic neurosis. Children with head nodding and rotatory spasm invariably recover when they are given treatment suitable for their impaired nutrition, which has been found in every case that has come under the writer's observation. This treatment does not differ from that indicated for rachitis. Rarely is it necessary to give a sedative, such as the bromides. I have seen marked benefit result in a number of cases from applying some support to the head and neck, as such as very light plaster collar, and in one protracted case recovery was quickened by applying a jury mast for a few weeks.

CHAPTER XLVIII.

THE TREATMENT OF HEMIPLEGIA.

Although hemiplegia is a symptom, not a disease, it is a condition which often causes the patient to consult the physician, and one that the latter is not infrequently called upon to mitigate or overcome. Unfortunately, in the majority of instances hemiplegia is attendant upon organic disease which has neither inclination to spontaneous cure nor responsiveness to medical treatment. In a few instances only is the lesion of such a nature and seat that it can be removed by the surgeon. Hemiplegia which is not the symptom of extensive vascular disease or progressive growths within the brain is oftentimes of prolonged duration, and the patient demands that something be done to mitigate his infirmity so that his usefulness and comfort may be added to. Many of the cases that are dependent upon vascular lesion, especially those occurring in early and middle adult life, are amenable to treatment in a measure, particularly if the latter be properly selected and applied. When undertaking the care of a hemiplegic it is essential to discover the condition upon which the symptom is dependent in order that causal and restorative teatment may be employed simultaneously.

The organic diseases upon which hemiplegia is dependent are inflammatory and hemorrhagic states of the meninges, intracranial tumor and abscess, encephalitis, multiple sclerosis, general paresis, and more frequently than any or all of these, hemorrhages, thrombosis, and embolism. The functional conditions with which it occurs are principally hysteria and transitory spasms of the blood-vessels. Occasionally it is an epiphenomenon of uræmia and a symptom of certain pathological states of the brain having an inherent tendency to recovery, such as localized œdema and cerebral hyperæmia.

Treatment.—The causal treatment of hemiplegia as well as the treatment directed immediately to the morbid condition upon which it is dependent, be it functional or organic, has been considered in the respective chapters dealing with these states. Here I shall consider only those measures that are available to improve the patient's most conspicuous infirmity or symptom, the hemiplegia. The measures that are of service in combating the paralysis are massage, forced movements attended or not with effort of the patient toward forcible movement, hydriatic procedures, general hygiene, and nursing. Electricity and medication play no considerable rôle. Passive movements are by far the most important measure in com-

bating the immobility of the joints of the paralyzed side, the atro
with which this is associated and causative of, and the contracture wh
develops in the muscles of the paralyzed side in the majority of case
hemiplegia. They should be instituted early, if possible, before an
these phenomena have made their appearance. It is particularly
joints of the upper extremity upon which greatest effort should be
pended, for the lower extremity and the face are apt to be much
involved. As soon as the patient fully recovers from the comatose st
the limbs of the paralyzed side should be subjected to passive moveme
for a brief period, at least twice a day. Some member of the fa
can be readily taught to do this. Beginning with the joints of the fing
each one should be forcibly put through whatever movements the const
tion of the joint allows; then the wrist, elbow, and shoulder joints ta
in succession. The same procedure should be adopted for the lower
tremity. The séance may be terminated by light massage, stroking
kneading movements, which are of service in improving the circulat
and general nutrition of the part. Massage must, however, be emplo
with circumspection, as it is capable of putting stress upon the intrac
nial blood-vessels and of fatiguing the patient to an injurious exte
Although the patient is quite incapable of making any voluntary mo
ment whatsoever, he should be encouraged to make the mental effort
voluntary movement simultaneously with the movement executed p
sively. This treatment should be kept up patiently and persistently
a number of months. In many instances it will be rewarded by t
development of sufficient mobility and dexterity to allow the patient
make considerable use of the extremity. A special procedure for t
re-education of the hemiplegic, particularly in walking, has been reco
mended by Erben. It is well known that the flexors of the thigh, t
extensors of the knee, and the plantar flexors of the tibiotarsal articul
tion are much less completely paralyzed in ordinary hemiplegia than t
dorsal flexors of the knee and foot. The greatest obstacle to the patien
locomotion after he has recovered sufficiently to attempt walking is t
difficulty of flexing the paralyzed leg when it is lifted from the ground
be advanced. In order to make up for this want of flexion of the kn
and the foot, the patient finds it necessary forcibly to flex the thigh
the paralyzed extremity on the pelvis, which allows the leg to be rais
and propelled forward. In order to obviate this and thus to facilita
locomotion, Erben has recommended that the foot of the healthy si
shall not be advanced beyond the line of the paralyzed foot. This nece
sitates that the patient take very short steps and walk very slowly; b
gradually it will transpire that the foot of the hemiplegic side can be p
further forward until a comparatively useful stride is acquired. Th
method of education naturally can be adopted only after the patient h
made sufficient recovery to begin walking.

Hydriatic measures, if employed with sufficient skill and discretion, can be relied upon to improve the general nutrition. They must, however, be used with great circumspection, as many of them are capable of putting such stress upon the intracranial blood-vessels, if they are diseased, that disastrous consequences may follow. Prolonged lukewarm baths, followed by passive movements and light massage, often lend some aid to the latter measure. The tonic effects of the cool splash bath may also be sometimes invoked. If there is advanced disease of the blood-vessels extremes of temperature are to be avoided.

Electricity in all its forms has been extensively tried in the treatment of hemiplegia, and is still probably extensively used. Patients readily become convinced that it is an agent of great serviceability to overcome their infirmity, and oftentimes make great sacrifice that they may avail themselves of it. The only kinds of hemiplegia in which it is of any service whatsoever are the flaccid variety in which there is no exaggeration of the tendon jerks, hemiplegia with hemianæsthesia and without marked contracture, and possibly also hemiplegia attended with considerable muscular atrophy. In hysterical hemiplegia it is naturally oftentimes of signal benefit. It may be stated that, as a rule, the faradic current should not be employed except in the functional variety. If used early it is very liable to add to the contracture or to provoke it. If it is thought advisable to use the galvanic current for the beneficial effect which it may have upon the circulation and nutrition of the paralyzed part, the positive electrode of large size should be placed over the back, and the negative electrode applied in labile fashion to the muscles of the paralyzed extremity. No effort should be made to cause them to contract by interrupting the current, except as stated above in the flaccid variety. The average hemiplegic individual thinks that it makes him feel better to have the paralyzed extremity treated with sparks from the static machine every day, and it is unquestionable that many of them walk more sprightly for a short time after such treatment. If there is no considerable contracture, and if the patient receives passive exercises as described above, this form of electricity may be employed advantageously. In hysterical hemiplegia it is of the greatest service, the paralysis sometimes disappearing after the first application.

The hygiene of the hemiplegic patient is a matter that calls for scrupulous attention on the part of the patient and family, and explicit directions on the part of the physician. Cleanliness of the skin is of the greatest necessity. The peripheral circulation is generally much depraved and trophic lesions readily develop, especially if the patient is taking considerable quantities of iodide of potassium. After the cleansing bath the skin should be covered with some bland, slightly antiseptic powder, such as oxide of zinc or subnitrate of bismuth, and parts that are particularly liable to pressure or irritation should be dusted repeatedly.

The bladder should be carefully watched, and if there is need for catheterization, this should be done regularly. The dietary and the state of the alimentary tract should receive the personal attention of the physician. Nothing is to be gained by the use of counter-irritants to the head or to the spine with the view of limiting secondary degeneration. No mention will be made of internal medication, for that depends entirely upon the condition which causes the hemiplegia, save to say that strychnine should not be administered. Even in cases in which the condition of the vascular system would seem to call for the tonic effects of this drug, the danger that it will add to the contracture is so real that it cannot be legitimately employed.

CHAPTER XLIX.

THE TREATMENT OF INSOMNIA.

INSOMNIA is a condition susceptible of definition by negation only, viz., the absence or want of sleep. Although the definition of insomnia is thus negative with reference to a condition which is accepted and well known as a normal physiological one, sleep till remains beyond the limits of ascertained knowledge of cause and effect, while the condition of sleeplessness has been subjected to careful examination. Although the causation of sleep is not as yet ascertained, the phenomena themselves are definite enough. The human being in sleep as contrasted with the same person awake is in a state of total unconsciousness. All sense of personality is gone, and for the most part emotions, sensations, and ideas cease to exist. It is not possible to decide to what extent this annihilation of the conscious life, these twinklings of oblivion, is merely a seeming and a forgetting. The chance recall of dreams, oftentimes suggested by some object or idea of the environment, warns us of the possible existence of mental phenomena during the sleeping state which under the ordinary circumstances of life do not connect themselves with the conscious memory, perhaps because they have not made a sufficient impression or because they have not established the requisite associations. With respect to the mental life, sleep may be of different degrees of depth, varying from a semiconscious state in which fleeting ideas and sensations may be subsequently recalled, either in whole or in part, to an absolutely dreamless state. This temporary abeyance of consciousness, whether complete or partial, is without doubt associated with the cessation of the functions of the cerebral hemispheres. It is perhaps safe to say that the progression from light to deep sleep marks a successive diminution of the functions of the frontal lobes, sensorimotor areas, and finally of the special sense areas. One cannot say that there is absolute cessation of function of the brain, although there seems to be. Increasing depth of sleep is marked by a similar progressive diminution of many or all of the functions of the body. The closer the functions are associated with the consciousness, and especially the volition of the individual, the more completely are the functions suppressed. Thus the striped muscles are almost always in a state of quiescence and flaccidity; the unstriped musculature, on the other hand, frequently retains its capacity for functioning, even though these functions are less pronounced. Digestion, breathing, the cardiac cycle, the circu-

lation, all continue; but all of them show marked depreciation of streng and activity. Depth of sleep is, therefore, not only proportional to t abeyance of consciousness, but also to this depreciation of all bodily fur tions. An approximation toward the state of sleeplessness or insomr may therefore be indicated as an approach to the normal waking phy cal and mental condition. As a symptom, however, which the physici is most frequently called upon to treat, the persistent continuance mental activity in some form is usually the signal feature.

Insomnia is therefore a relative term. The amount of sleep th suffices for one individual would be productive in another of such depra ity of nutrition that might lead to disease. In discussing its causation a treatment, we must therefore bear in mind that the individual equati must be determined in every instance. Sleep is measured by its dep as well as by its duration. Difficult as it may be to express in absolu figures the requisite quantity of sleep for the normal human being in pe fect health, it is still more difficult to describe at all adequately the rel tive degrees of depth of sleep, but experience teaches that the deep the state of sleep may be, that is, the more profound the cessation of no mal physiological and mental functions, the less protracted need th sleep be in order that the individual may receive adequate physiologic restoration and refreshment.

I have hitherto considered sleep only as it contrasted with th normal waking state. Sleep is one of the many periodic phenomen of the human organism of which menstruation is the most remarkabl and typical. It may be said that the normal human being, uncontam nated by the requirements of a civilized environment, will fall int the state of sleep after the taking of food, and at the onset of dark ness; that he will continue in this state until the light of day agai revives his depreciated functions, or until hunger or some other signa stimulus acts with sufficient intensity to arouse the functions of the cere brum, with which will reawaken all the activities of the body. Th sleeping organism ought, therefore, to be undisturbed by internal or exter nal stimuli. In the proportion that these tend to awaken consciousness in that proportion will they diminish the depth of sleep and its consequen restoration. The period from nightfall till early morning is both th time indicated by the very nature of man's organism, for the "blesse barrier between day and day" and also the time when he is least likel to be disturbed by these external and other stimuli. Were it not for th associated factors of noise and light, it is not at all unlikely that sleep ob tained during the day would be as refreshing and beneficial as sleep ob tained at night. That many of those who are perforce compelled t work during the night, or those who voluntarily elect to do so, suffer ever though they obtain the full complement of sleep measured by hours, im pairment of nutrition and strength is not so much due to inadequate slee

as to the effects of artificial light and vitiated air, associated as they often are with indulgence in stimulants, and with other hygienic infractions.

Classification and Causation of Insomnia.—Insomnia is a concomitant of many functional and organic diseases, and it often occurs apart from either. It will facilitate our discussion of the treatment of insomnia to discuss briefly the causes of insomnia, and attempt a classification. Sleeplessness might be classified according to the time of its occurrence, as the insomnia of different times has been shown to stand in definite relationship to different etiological factors. For instance, one class of sufferers have great difficulty in getting to sleep. If they are allowed to prolong their slumbers into the day, there are usually no ulterior consequences; but as duties compel them to arise at a stated time, they suffer from the effects of curtailed sleep. Moreover, the misery attending impotent efforts to secure sleep assists to exhaust the sufferer's strength and nerve energy. This variety of sleeplessness has rather uniform causation, and is commonly dependent upon mental conditions. It not infrequently has its beginning in purposeful curtailment of sleep, that the time devoted to work may be greater. So many forget that—

> "Not poppy, nor mandragora
> Nor all the drowsy syrups of the world,
> Shall ever medicine thee to that sweet sleep
> Which thou owdest yesterday."

Another variety of sleeplessness consists of profound drowsiness, often terminating in sleep even though the patient makes great effort to avoid it, which comes on in the early evening, followed after an unrefreshing slumber of varied duration either by repeated and apparently causeless awakenings or by complete awakening and mental alertness. Insomnia of this kind is most commonly associated with infections and intoxications, particularly auto-intoxications. It is, of course, more liable to occur in neurotic individuals. A third variety of insomnia is that which consists of persistent repeated early awakening, such as at four o'clock, before the requisite number of hours of sleep have been obtained. Insomnia of this kind is commonly associated with organic disease of the blood-vessels, such as arteriocapillary fibrosis and kidney disease; with intestinal indigestion, and occasionally with the excessive use of alcoholics, such as champagne, and narcotics, such as morphine. Finally may be mentioned a variety of sleeplessness in which the adequate number of hours is apparently obtained, but it is not followed by the refreshed feeling of invigoration as normal sleep should be.

It will best serve my purpose, however, in discussing the treatment of insomnia to classify this symptom according to its causation, and not on a temporal basis as indicated above. Sleeplessness may thus be classified as due to:

1. Exalted states of the sensory sphere. Hyperæsthesic conditions,

of which pain is the best example. This group includes paræsthes every kind, formication, buzzing and ringing in the ears, suffocation, choking feelings. It may also include so-called reflex insomnia suc from adhesions of the prepuce and clitoris and irritation from intes worms.

2. Psychical causes: anxiety, grief, fear, worry, overwork, inab to dismiss recurring thoughts or trains of thought, mental exaltation depression. There might also be included under this head such co tions as change in the mode of life and environment, which migh looked upon as both psychical and physical.

3. Toxic causes, of which there are three distinct subdivisions: the infections, such as from acute diseases, as pneumonia, typhoid fe scarlet fever, etc.; (*b*) exogenous intoxications, alcohol, tobacco, coffee, drugs, etc.; (*c*) auto-intoxications, from disorders of digestion, acid, gout, rheumatism, diabetes, uræmia, and excessive bodily fatig

4. Insomnia of organic disease, principally vascular, such as dis of the heart and arteriocapillary fibrosis.

5. Habitual insomnia. This is an uncommon form of insomni which there seems to be no dependency upon bodily or mental disor Under certain circumstances it may exist for a long time without prod ing either of these. When they develop, as they eventually do, it comes difficult to differentiate cause from effect.

Treatment.—The first and most essential factor in the treatment of somnia is to discover its cause and, if possible, remove it. When it is such a nature that it is impossible to remove it, then measures looking to ard its mitigation must be adopted. The routine treatment of insomn particularly by the administration of hypnotics, all of which are injurio is always dangerous as well as most unscientific. Insomnia is a sympt of so many entirely dissimilar diseases that it is most unjustifiable treat every case in the same way. There are, however, certain measu which can be applied in the treatment of insomnia in something like ro tine fashion to great advantage, but these measures do not include dru I shall discuss these briefly before giving special consideration to t different forms of insomnia. Another important feature to bear in mi in treating insomnia, that causal therapy may not be disappointing, that after sleeplessness has continued for any considerable time, it is n only necessary to determine the nature of the insomnia and to overcor the conditions upon which it is dependent, but to break up the habit sleeplessness as well. To accomplish this the hypnotics are of the grea est value.

The general treatment of insomnia must consider the individual a his environment. Not only should the bedroom be selected with refe ence to the exclusion of noises and other distractions, but it should large, well ventilated, devoid of unnecessary furniture, especially t

kind that makes a room stuffy, and one in which the patient feels comfortable. The bed, its covering and pillows, should contribute to repose and comfort. The individual must be considered in reference to his habits and customs, regarding preparation for sleep, whether it be in walking, bathing, reading, eating, drinking, or even smoking. Some persons find it quite necessary to partake of some easily digested food or mildly stimulating drinks before retiring, while for others reading or being read to is conducive to sleep. Although much has been written of the efficacy of directing the thoughts toward some monotonous task, such as reciting, counting, or calling up soporific mental pictures in inducing sleep, it is really a very unimportant measure. Few, unfortunately, are so well provided for, that they like the poet have banks that are furnished with bees whose murmur invites one to sleep. Not a few find it advantageous to expose the naked body to the cool air, to make cold ablutions, to take warm foot baths, or to hold the feet for a few seconds under running cold water. All of these may at times be indulged in advantageously, especially if the insomnia is dependent upon psychical causes or habit. Insomnia associated with or dependent upon organic disease of the blood-vessels is often successfully combated by instructing the patient to take a small amount of stimulant, such as whiskey and hot water or milk, on retiring, and repeat this in the early morning. The danger that the patient may contract the alcohol habit should make one careful in prescribing such treatment for insomnia due to psychical causes, especially in women.

Of the general measures in the treatment of insomnia, the application of water is perhaps the most important. A prolonged warm bath, to which may be added volatile substances that irritate the skin and cause a determination of blood thereto, such as pine-needle extract, is frequently efficacious in insomnia due to psychical causes, mental and physical exhaustion, and a mild degree of pain or paræsthesia. Occasionally a bath of this kind is more efficacious if it is followed by massage. A moderately prolonged bath of from 102° to 108° F., after which the patient is wrapped in a flannel blanket for a few minutes until it absorbs the moisture, and is then exchanged for the night dress, followed by the application of cold compresses to the head, is often serviceable in the same conditions. In neurasthenia and hysteria the dripping sheet (see chapter on Hydrotherapy) and the Neptune girdle are sometimes serviceable.

Massage is another available general agent in the treatment of insomnia, particularly insomnia dependent upon psychical causes. The most advantageous form in which to administer it is general massage, which can be given very vigorously up to the point of fatiguing the patient, providing there be no physical infirmities contraindicating its use. Throat stroking and massage of the feet are also sometimes of great service.

Some cases of sleeplessness, particularly those associated with continual recurrence of the same thought or trains of thoughts, are amenable to light percussion of the head, and an apparatus has been devised to apply this by means of the electrical current.

Sleeplessness due to pain constitutes comparatively a small proportion of all cases. It is combated by the use of measures that relieve the pain. Morphine does this with more certainty than anything else. Considering the danger that attends its use, of which every one knows, it is necessary to interpret the dependency of the pain. If it is due to some intractable or incurable disease, its administration is not justifiable so long as a degree of relief from the pain and insomnia can be obtained from the use of other pain relievers, whose administration does not entail habituation. If it is not, morphine should be given to the complete relief of the pain. If this does not suffice to overcome the sleeplessness, one of the least innocuous hypnotics should be used simultaneously. Sulfonal and trional in from twenty-five- to thirty-grain doses meet the indications. Trional acts more expeditiously than sulfonal, and its effects are not often manifest the next day as are those of the former. Their action is often expedited if given with a small quantity of some alcoholic, such as sherry or whiskey, or hot milk. Some cases of insomnia associated with pain dependent upon chronic organic or functional disease, such as tabes or neuralgia, respond with greater certainty to chloral than to any other hypnotic. The immediate and remote effects of this drug should make us chary of its repeated use.

Sleeplessness dependent upon paræsthesia is overcome by the utilization of measures that immediately combat these conditions. It is difficult oftentimes to determine the dependency of the paræsthesia. For instance, the complex of symptoms known in this country as the paræsthetic neurosis and abroad as acroparæsthesia, is due to different causes, many of which are unknown. Studious consideration of the patient's history and careful investigation of the different systems of the body will usually reveal the cause. Then measures may be taken to remove it and to combat its effects. These may include a change in the patient's mode of life and dietary to overcome autointoxication and a beginning diathesis, such as the uric acid, or the administration of vascular stimulants such as strychnine to aid a jaded heart. After these indications have been fulfilled the insomnia may still persist, but this can usually be overcome without resorting to hypnotics by the use of hydriatics and massage.

Insomnia associated with sensations of suffocation and strangulation usually succumb to measures directed immediately to the hysterical conditions of which they are a part.

Sleeplessness dependent upon psychical conditions, such as anxiety, grief, worry, fear, overwork, obsession, excitement, or depression, wheth-

er or not there be ancillary phenomena of disease like neurasthenia, hysteria, hypochondriasis, mania, or melancholia, is the commonest variety of insomnia encountered by the neurologist and probably also by the general practitioner. It is usually the most difficult to treat because the state upon which it is dependent, although discoverable, is not easily overcome. Many of these conditions do not respond readily to treatment, while the measures adequate to cope with others are often unfortunately beyond the patient's reach. Sufferers with insomnia of this kind become victims of drug habits more often than any others because of the refractoriness of the conditions of which it is a symptom. These morbid states require to be vigorously assailed and overcome if possible. In endeavoring to do this, one will make use of hypnotics, massage, rest, and exercise, sport, occupation, dietary, electricity, drugs, or anything else available which seems to be indicated. The specific application of these are considered in Part I., and in the respective chapters devoted to the consideration of these diseases. Here it is necessary to say something of the various hypnotics, one or all of which may have to be given. Despite the many new and excellent sleep-producers, the most reliable hypnotic at the present day is chloral hydrate. A knowledge of the immediate and remote dangers attending its administration should counsel its use as rarely as possible. The only absolute contraindication to its use is degeneration of the cardiovascular apparatus. There are many asthenic conditions in which the administration of chloral is inimical, but if it is absolutely necessary to give it, the system can be fortified and protected by the simultaneous administration of other drugs or measures so that its use will be attended with no considerable risk. For instance, chloral hydrate is a very serviceable drug in the treatment of the insomnia following abstinence from alcoholic stimulants and morphine. When it is given for such conditions the simultaneous administration of some cardiac stimulant as strychnine, strophantus, or sparteine is nearly always indicated. Of the modern chloral derivatives, chloralamide and chloralose are the most serviceable. The former is in reality a very serviceable hypnotic. Its use is free from risk that the patient will form a habit, and it is neither a solvent of the red blood corpuscles nor a profound depreciator of cardiovascular pressure, like chloral. It may be given in twenty- to forty-grain doses. Ususally no disagreeable after-effects attend its use. Chloralose in from five- to ten-grain doses is a fairly reliable hypnotic, and may be given under the same circumstances as chloralamide. It is useful, particularly, in the sleeplessness of mental irritability and exhaustion. Amylene hydrate is a less powerful sleep-producer than chloralamide, but it is not disagreeable to take and it has no unpleasant after-effects. The average beginning dose is a drachm. Sulfonal, trional, hypnal, and hypnone, especially the first two, are among the most serviceable drugs in the treatment of insomnia; not only because of their effica-

cy, but because of their comparative innocuousness. The average dose of each of them is from fifteen to twenty grains, and there are practically no contraindications to their use save profound asthenia. They find their widest field of usefulness in the insomnia dependent upon psychical causes and febrility unattended with pain.

Next in certainty of action to chloral hydrate in the overcoming of insomnia due to psychical causes is paraldehyde. Were it not for its disagreeable, persistent odor and its nauseous taste, it would approximate the ideal hypnotic. Its use in drachm doses is unattended with danger, and in many cases two or three times this amount can be given with perfect safety. It has but slight depressing effect upon the heart, and trifling depreciating effect upon the tissues. It has, however, a tendency to disorder digestion, and must be used carefully for patients with sensitive stomachs.

The salts of bromine are used very largely in the treatment of insomnia, with the mistaken idea that they are hypnotics. Although they often induce sleep, they are no more hypnotics than is morphine. They contribute to sleep by relieving the peripheral or central irritation upon which the wakefulness is dependent. For instance, in states of erethism associated with cerebral hyperæmia, the result of some poison acting through the heart or directly upon the blood-vessels of the brain, or a concomitant of mental excitement, a full dose of one of the bromides will go far toward contributing to the tranquillity which precedes sleep. They are often combined with chloral to bring about such a state in the treatment of insomnia of asthenic delirium and auto-intoxications. In some cases of sleeplessness dependent upon mental irritability it is better to give 15 grains of bromide of sodium one hour after each meal instead of giving a large dose at bedtime, but it should not be forgotten that the bromides should never be given repeatedly nor continuously in order to induce sleep.

The indications for the treatment of insomnia dependent upon toxic materials in the system, whether they be taken in from without or manufactured and elaborated within, are comparatively simple, even though the sleeplessness does not always yield readily. The first and most important thing to do is to determine the cause, then to remove it or combat it. It is sometimes as difficult to do the one as the other. Sleeplessness accompanying the infectious diseases is often ameliorated by appropriate treatment directed against the fever, but it is frequently necessary to administer some hypnotic as well. The election of the hypnotic will depend largely upon the state of the patient's vitality, especially the condition of the heart. The fact that sulfonal and trional have only slight depressing effect upon the vascular system makes them the safest for this purpose. Insomnia of the exogenous intoxications is often very rebellious to treatment, even after the source of the intoxication has been

shut off. Cases of this sort furnish opportunity, and with a fair prospect of success, for the utilization of the physical measures that have been mentioned. Remedies that are capable of combating the general depreciation of vitality, manifest by disorder of circulation, digestion, and assimilation, must be given simultaneously. Of the hypnotics to be used in insomnia of this class, paraldehyde is by far the most reliable. Chloral, its derivatives and compounds, are to be avoided, principally because of their effect upon the blood. The same may be said of the bromides. When symptoms of general erethism indicate the administration of these salts for their calming effects, they should be given only for a brief period. In treating the insomnia of auto-intoxication from disorders of digestion, uric acid, gout, diabetes, etc., the administration of hypnotics should be delayed as long as possible, and then used very sparingly because of their capacity to impair digestion and assimilation and to retard metabolism. Regulation of diet, attention to the avenues of elimination, appropriate exercise, the use of hydriatics and massage, and the administration of remedies that operate directly upon the auto-intoxication, are the measures to be relied upon. Hypnotics should be used as sparingly as possible.

Great care and skill are necessary in the treatment of insomnia due to organic disease of the viscera in which the sleeplessness is not due directly to pain. Disturbed and unrefreshing sleep, dyssomnia, is one of the most constant symptoms of arteriocapillary fibrosis. The proper administration of iodide of sodium or potassium and one of the nitrites and careful alimentation do more to relieve this symptom, except it be temporarily, than does anything else. Naturally, it is often necessary to administer sleep-producers. The selection of the most serviceable one will be aided by a consideration of the causes and extent of the vascular disease. Sulfonal or trional administered with a small quantity of alcoholic stimulant, taken when the patient awakens after a more or less brief sleep in the earlier part of the night, is often very useful. Chloralamide and chloralose, given in moderate doses until the tolerance of the individual has been determined, can be alternated with them.

No special rules can be given for the treatment of the form of insomnia known as habitual, as the indications vary with the individual, and what will prove of benefit to one will be quite useless for another. Many of those constituting this class of patients secure in reality sufficient sleep to maintain a fair degree of health. Thus many who aver that they obtain scarcely any sleep get sufficent "to knit up the ravell'd sleeve of care" for they do not lose weight nor suffer diminution of hæmoglobin, although they may lack strength and energy. Change of surroundings and mode of life sometimes benefit those who can avail themselves of them. But for the majority auch luxuries are impossible. Many drug habitués are recruited from this class. Hypnotics should, therefore, be given with the greatest circumspection.

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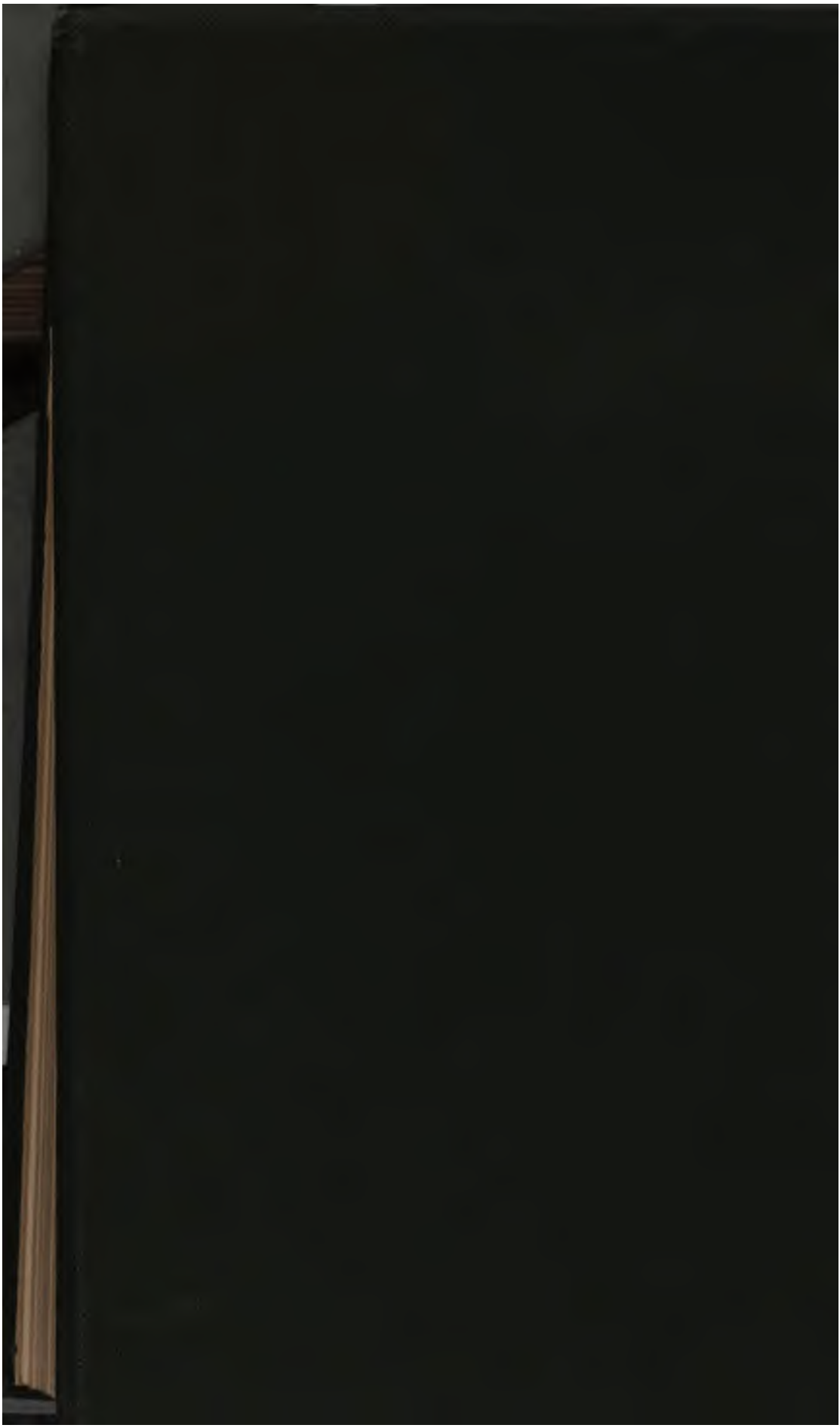
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